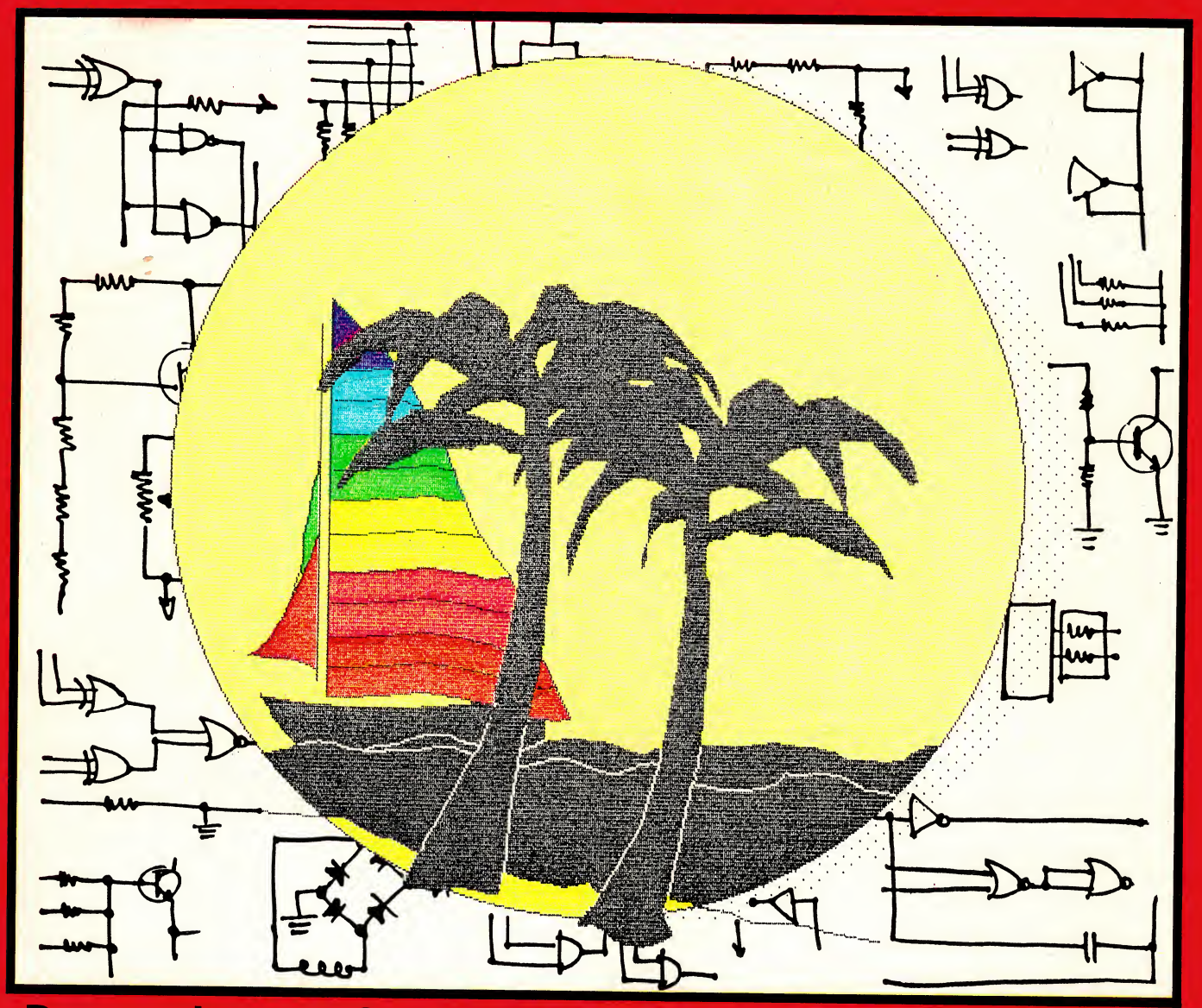
The Independent Magazine for Users of Heath/Zenith Microcomputers

SEXTANT

$2.95 September-October 1986 Issue No. 24



Beaches, Gate Arrays, and the Z158

Probing the Subconscious Memory of the Z100

A Fail-Safe Disk-Mount PROLOGUE for HDOS

Sorting on Your Terms, Not the Computer's

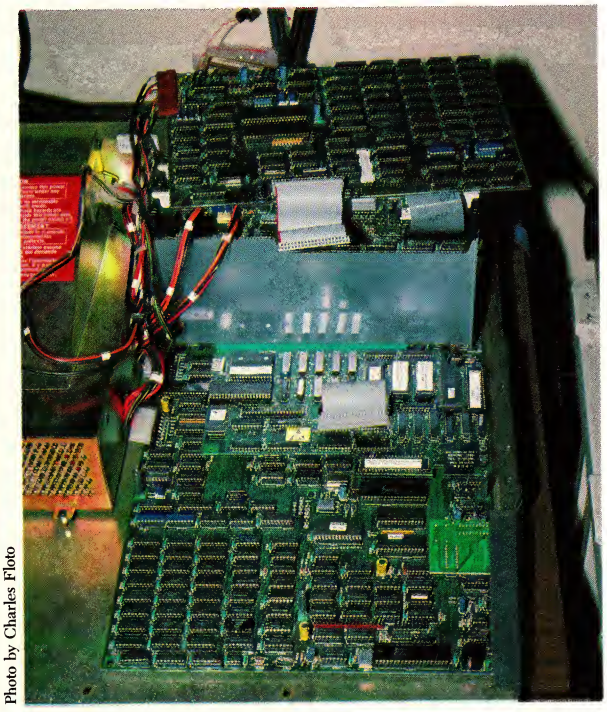


Photo by Charles Floto

64

How hard is it to give your Z100 a dual personality? How much IBM-compatibility do you get with the Gemini Emulator Board? Does it have any weak points? What are the alternatives? You already know the questions, so here are the answers.

Photo by Charles Floto

68

Did the Midwest have what it takes to get another regional conference off the ground? Well, we learned a lot that weekend, and we'd like to share some of it with you.

SEXTANT

Features

New Life for the Z150 from Gate Arrays 9
James C. Kunze
Here's how Zenith Data Systems coped with price competition and increased the performance of the Z150 at the same time. As a bonus, they ended up with two smaller computers: the Z138 and Z148.

Probing the Subconscious Memory of the Z100 17
Gary R. Cramblitt

The Eight-Bit World 25
Walter J. Janowski
The eight-bit world is even busier than expected. Doubling the clock speed of the H89 helps keep up. One program it makes a big difference with is Home Finance System. Another software option to consider is MEX.

Print Big in BASIC (or Turbo Pascal) 33
Peter Wentworth
Here are three different ways your H/Z100 can shout what you type on its keyboard in letters big enough to read from a distance. Most of the discussion covers doing it with Z-BASIC, but a Turbo Pascal implementation is thrown in as a bonus.

Z100 Notebook 37
William N. Locke
Can the flashy Z248 seduce a loyal Z100 user? Why bother with batch files? What's new with Perks? Those are three of the questions taken up in this installment. We also look at REACH86 and venture into a new area of Z100 programming.

A Fail-Safe Disk-Mount PROLOGUE for HDOS 42
Duane W. Small
Before MS-DOS had AUTOEXEC.BAT, HDOS had PROLOGUE.SYS. This can be used to mount disks automatically. But doing so leads to a hangup if there's no disk in the drive. Unless, that is, you use the program presented here.

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C Notes
Joseph Katz 47

Notes on Computer Innovations' C86 and Essential Software's C utilities. With a sample program which uses the latter.

Sorting on Your Terms Rather than the Computer's
Thomas F. Best 51

Here's a Tiny Pascal solution to the special sorting problems of bibliographies. It might be applicable to your needs in sorting entries of arbitrary length. If not, perhaps you can pick up some hints on customizing software to your own requirements.

IBM Emulation with the Gemini Board
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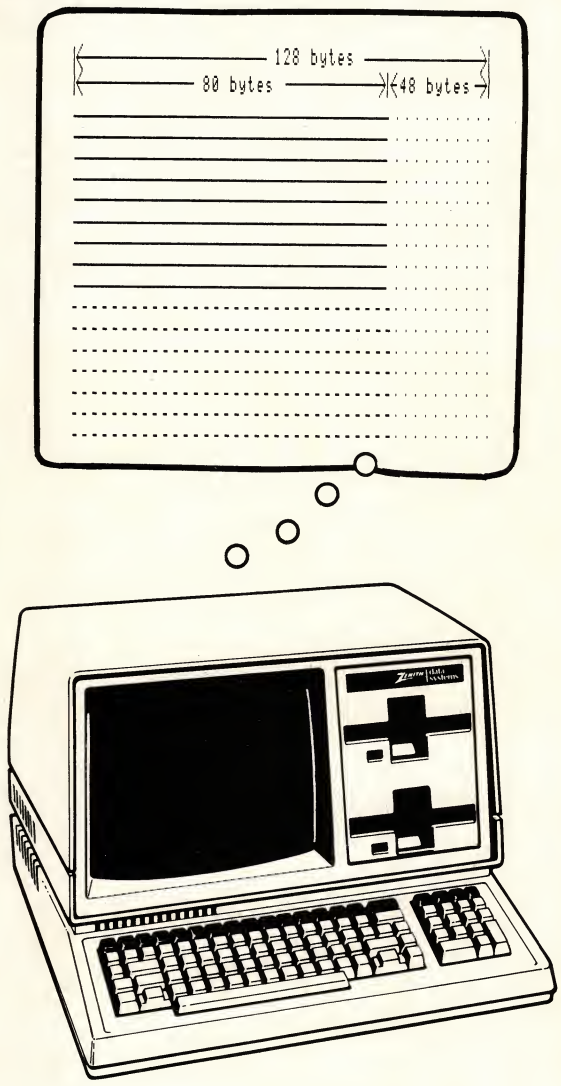
Cover design by Janet Hirsch of Smart Graphics (314/962-7833) created with a Z100 in high resolution graphics mode (640 x 480).



17 An H/Z100 can have from 10,000 to 76,000 bytes of memory that's never used. Here's a map of that wasted RAM—with some precautions to take if you decide to venture within its boundaries.

The Editorial Eye

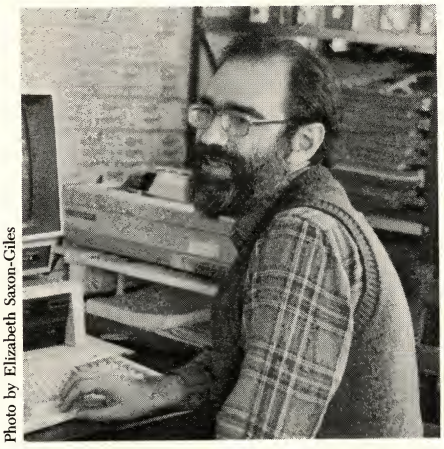


Photo by Elizabeth Saxon-Giles

In January of 1977, the Heath Company announced it would be making digital computer kits. I imagined the day when these computers would be used with Heathkit televisions and linked together through Heath amateur radio gear.

Nine years later, Heath has exceeded my expectations in at least one respect. They've announced a computer peripheral and software to allow an H/Z150 system to be used as a "dual trace 50 MHz digital storage oscilloscope." (See page 73 for details.)

Heath's first electronic kit was an oscilloscope, designed around parts acquired as surplus after World War II. This is one area in which they shouldn't have to worry about competition from IBM or Apple. Two other companies do have design experience with both microcomputers and oscilloscopes: Texas Instruments and Hewlett-Packard.

Heath has taken advantage of microprocessor technology in several of their product lines. Explicit computer connections have at least been flirted with in amateur radio, education, and weather products.

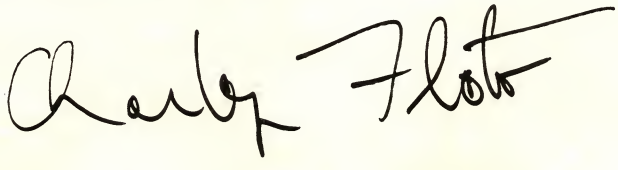
I'd like to see some Heathkit computer peripherals serving another area in which they've long been active: home video. Heath was making excellent television kits even before Zenith bought the company. Their strength in combining computers and video equipment could be rivaled only by Sony. That vendor already offers a videodisc player with RS-232 serial interface.

For starters, how about a mixer to combine composite video from a Heath/Zenith computer with another video source and feed the output to a video cassette recorder? About a third of U.S. households are VCR sites—a figure predicted to double by the end of the decade. Some of us would like to move beyond controlling the viewing agenda to creating our own videos. Why not mix in some computer graphics? There might even be some applications in the education markets Zenith has courted so successfully.

Digital signal processing is coming to TVs and VCRs. Zenith is active in this area. Their computers shouldn't be left out. A number of suppliers are already supporting the integration of video and computer graphics on Commodore's Amiga.

I got my VCR in late June. My first major taping project was ABC's coverage of Liberty Weekend. The weather was unusually pleasant for Washington on the Fourth of July, so I wanted to enjoy the parade and concerts on the Mall. I also appreciate having a record of the festivities in New York. I hope they'll give me some more ideas for celebrating *Sextant*'s fifth anniversary next Spring. My first thought was of a Gala Fifth Anniversary Subscription Rate Increase. You'll be hearing more about it as the time approaches.

After a bit of uncertainty, CHUGCON 86 has been set for October 25-26 at the Sheraton Tysons Corner Hotel in northern Virginia. This is on Route 7 at the road to Dulles International Airport. Details from the Capital Heath Users' Group, P.O. Box 16406, Arlington, VA 22215-1406. October is a good time to enjoy a weekend (or more) in this area. CHUG has scheduled a banquet for Sunday evening to encourage you to do just that.



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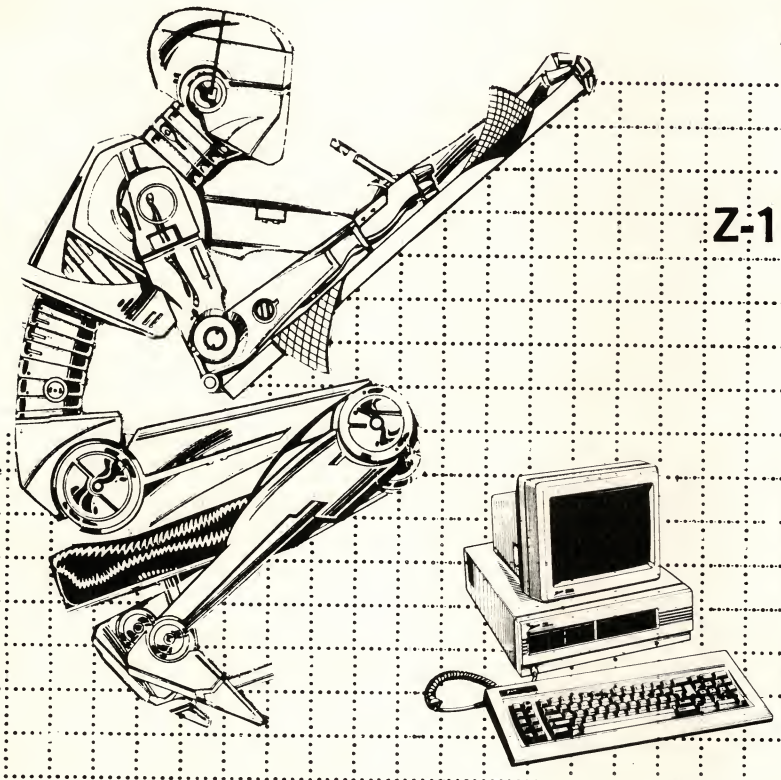

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Letters

Correction to WSTOASC

Re: WSTOASC program in May-June 1986 *Sextant* ["C Notes," by Joseph Katz].

In converting a WordStar™ document file to ASCII format, you forgot about the soft-hyphen at the end of a line which *must* be converted to a hyphen. This is easy to do since a soft-hyphen at the end of a line has a different code than a soft-hyphen inside a line.

The correction to Listing 4 (page 67) would be as [shown in Listing A].

Keep up the good work.

Theodore A. May
Vanier, Ontario, Canada

Setting the Z100 record straight

I've just finished reading the interview with Dave Brockman in the July-August issue of *Sextant*, and I'd like to set the record straight about a few things.

Dave says that he doesn't think as many Z100s were sold as Z89s. In fact, reliable sources tell me that the total number of '89s (all variants) sold over the life of the product was approximately 20,000 to 25,000, while the number of '100s sold will probably end up being around 100,000 (although the '100 is still being sold, so the final number is not yet determined). Thus, the Z100s have significantly outsold the '89s, although because of the '100's greatly reduced need for aftermarket expansion, and because of the large number in government/military/institutional hands, it might not appear that way to an aftermarket supplier.

As to the matter of why the Z100 was not IBM-PC compatible, the Z100 was first proposed by me in essentially its current form (dual processors, bit-mapped color graphics, dual 5″/8″ floppy disk controller, S-100 bus, etc.) in a written product-line plan submitted to Jay Jarrett (now with Tecmar) in October 1979. Bill Johnson also received a copy, although as far as I know, no one else saw it. The Zenith acquisition of Heath became effective on October 1, 1979, and due to internal politics and the formation of ZDS as an independent organization, no action was possible on the plan at that time.

The plan for the Z100 (the -100 designation *was* a consequence of the product's intended use of the S-100 bus) was subsequently revived in the last quarter of 1980, and approved in principle in the first quarter of 1981. The actual circuit and mechanical design were started in earnest in March of 1981, and were complete by early July 1981, *before the IBM PC was announced*, much less available for examination. The Z100 was shown publicly for the first time at NCC in Houston in June 1982, and first shipped around September 1, 1982. *The reason that the Z100 is not IBM-PC compatible is that its design was complete before the IBM PC was even announced.*

For the record, the primary designers of the Z100 were myself (concept and architecture), Mike Hakeem (engineering management), Babu Rajaram (circuit design), and Chuck Krause (also circuit design). Gregg Chandler did the ROM firmware, and was also instrumental in the video mapping architecture. Many other individuals in the company, both in engineering and in other departments, made significant contributions, without which the project would never have resulted in a successful product, but there is not space to list them all.

Keep up the good work for the Heath/Zenith community.

Barry A. Watzman
Benton Harbor, MI

Compiling fractal programs

When the July-August issue arrived, I turned immediately to Mr. Byrnes' article on fractals, and before sundown, my H100 was churning away. As a person who spends (wastes?) countless hours watching patterns develop on the screen, the need for patience wasn't anything new, but even at 8 MHz, this was agonizingly slow.

Without much thought, I reached for my little-used compiler and attempted to compile the program. After getting over the "missing /E switch" hurdle, I again set things into motion and settled back with one eye on the screen while idly browsing through the compiler manual. It wasn't long before I ran across the list of ZBASIC commands (including BSAVE and BLOAD) not supported or "supported differently" by the compiler. Since the program had compiled without error and was creating an interesting image, I decided to just let it run and went off to bed.

The next morning, I discovered that the program had terminated normally, and a quick DIR B: revealed the presence of three 64K image files. After several hours of experimentation, I can't detect any difference between these files and the ones created using the interpreter. Partial or complete screens can be saved using the interpreter and loaded with a compiled program and vice versa.

I *was* surprised to learn that color planes couldn't be swapped by means of DEF SEG and BLOAD commands. This is true of screens saved by compiled or interpreted programs. The DEF SEG statements have no effect and, in fact, may be eliminated. A quick look using DEBUG revealed that the second and third bytes of each file contained the base address of its respective color plane. Changing these values does allow you to swap complete color planes. It is interesting to make two extra copies of each file, modify the base addresses, and then experiment with loading various combinations of all nine files. It's easier to see the effects using a floppy disk, but it's more impressive using a RAM disk. Using a RAM disk, loading each plane takes just about the blink of an eye. Now I want to figure out a way to OR, XOR, and AND the image files.

My compiler is Heath/Zenith MS-463-4, Serial Number 000-00012368-8, Version 5.4, dated 05-27-83. The computer is an H110 with an old motherboard modified to 8 MHz/768K using an HA-108 kit and following the instructions published in *REMark* magazine.

I've always heard that ignorance was bliss, and this experience suggests that there is an element of truth in the

First, insert a define statement:

```
define SHYPH_E 0x1F                    /* End-of-line soft-hyphen */
```

Next, modify the while statement as follows (changes are in boldface):

```
while ((c = getc(input)) != EOF)                    /* Flow control */
{
        c &= 0x7F;                                  /* Unset high order bit */
        if (c == SHYPH_E)                           /* If end-of-line soft- */
            c = '-';                                /* hyphen, replace it */
        else if (iswordstar(c))                     /* Skip garbage */
            continue;
        putc(c, output);                            /* Keep a good one */
}
```

Listing A. (See "Correction to WSTOASC," above, left.)

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old adage.

I'm looking forward to the fractals contest, and will probably send in an entry or two.

Keep up the good work.

Robert D. Williams
Hampton, VA

Clock boards and line feeds

I have recently purchased a Zenith 158 and started subscribing to your magazine. The first issue I received was issue #22. Based on some of the letters and articles inside, I believe there is an ongoing discussion about real-time clock/calendar boards and the problem of double line feeds when using the Radio Shack Daisy Wheel II printer with Zenith computers. I am seeking help for a clock/calendar board because I am experiencing some problems with it, and I would like to expand on the problem of Radio Shack DWII printers and MS-DOS.

Clock/calendar problem: I have an AST 6-Pak clone that features a clock/calendar option. The problem is that whenever I read from the real-time clock on the board at 8 MHz, I get garbage characters and incorrect time. It always works fine at 4 MHz. If I fail to select 4 MHz when reading the board and setting the computer's internal clock, I get garbage. The maker of the clock chip, National Semiconductor, says that they do not have a faster compatible clock chip (MM 58167). I called AST and they said they haven't tested the board on a Zenith 158, and that

```
TESTING FOR UPDATED RS DW II ROM

1. Turn your printer 'off' then 'on'
2. Get into basic and type the following program

 10  LPRINT "LINE 10, TEST FOR EXTRA LINE FEEDS"
 20  LPRINT "LINE 20, TEST FOR EXTRA LINE FEEDS"
 30  LPRINT "LINE 30, TEST FOR EXTRA LINE FEEDS"
 40  LPRINT "LINE 40, TEST FOR EXTRA LINE FEEDS"
 50  LPRINT CHR$(27);CHR$(21)
 60  LPRINT "LINE 60, TEST FOR SINGLE SPACING"
 70  LPRINT "LINE 70, TEST FOR SINGLE SPACING"
 80  LPRINT "LINE 80, TEST FOR SINGLE SPACING"
 90  LPRINT "LINE 90, TEST FOR SINGLE SPACING"
100  LPRINT CHR$(27);CHR$(22)
110  LPRINT "LINE 110, TEST FOR EXTRA LINE FEEDS"
120  LPRINT "LINE 120, TEST FOR EXTRA LINE FEEDS"
130  LPRINT "LINE 130, TEST FOR EXTRA LINE FEEDS"
140  LPRINT "LINE 140, TEST FOR EXTRA LINE FEEDS"

3.  Type "RUN" to execute the program
4.  Lines 10-20 should print with extra line feeds
5.  Lines 60-90 should print with single (standard)
     line feeds if you have the updated ROM else you
     will continue to get the extra line feeds
6.  Line 100 contains the escape  sequence to reset
     your printer back to extra line feeds
7.  Lines 110-140 should again appear with the extra
     line feeds
```

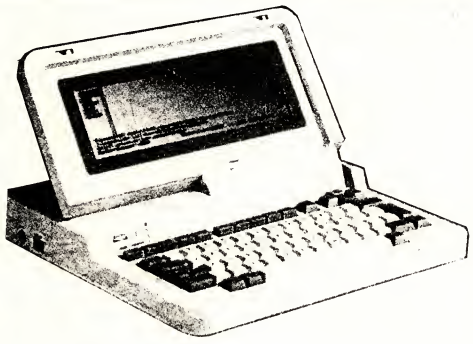
Figure A. (See "Clock boards and line feeds," left.)

```
BASIC(A)
Somewhere before your first "LPRINT" statement
include the following.   Do not type the quotes.

"LPRINT CHR$(27);CHR$(21)"

note: make sure you have the printer on before your
program executes this line or unpredictable items may
happen.
```

Figure B. (See "Clock boards and line feeds," left.)



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```
COM FILE
Probably the easiest way to create a com file of this
length is to use "Debug", and name it singlspc.com.


     A>debug
     -n singlspc.com
     xxxx:0100 mov dl,1b
     xxxx:0102 mov ah,05
     xxxx:0104 int 21
     xxxx:0106 mov dl,15
     xxxx:0108 mov ah,05
     xxxx:010A int 21
     xxxx:010C int 20
     xxxx:010E
     -r cx
     CX 0000
     :e
     -w
     Writing 000E bytes
     -q

Note: There are at least four advantages of creating
a "COM" file over using "Basic".
     1. It can be executed directly without having to
        get into basic.
     2. It can be executed from within other programs
        if your software allows it.
     3. It can be executed from a "Batch" file.
     4. It gives an error warning if your printer is
        not on.
```

Figure C. (See "Clock boards and line feeds," page 6.)

the problem probably lies in the Zenith BIOS. I know my board works in a speeded-up IBM PC with Turbo-DOS. I do have a program that reads from the real-time clock, but I do not have the source code. Do you know of a way to help me, or know of an assembly language program that correctly reads the board's real-time clock at 8 MHz and puts it into memory?

Radio Shack DWII printer: I was experiencing the same problem Joseph Katz discussed in "C Notes" on page 58, issue #22. His diagnosis is 100% correct. However, the procedure of issuing an escape sequence of 27,21 (1B,15) to defeat the extra line feeds should be elaborated. Early versions of the DWII do not recognize the escape sequence to defeat the extra line spacing; later models do. The reason is simple. Radio Shack changed their printer ROM. I believe all DWII B's have this new ROM, and some standard DWII's. It is a simple matter of testing the escape sequence to see if you have the updated version of the ROM. (See Figure A). If you do not have the new ROM, it may be obtained from Radio Shack National Parts, 817/870-5662, by asking for part #AMX-4805. It costs approximately $20. If you don't think you can install it yourself, your local Radio Shack repair center can order it and install it for approximately another $25.

Since I do not have C, I am offering other suggestions to help correct the extra-line problem. One is executed from "BASIC(A)" (Figure B), and the other is a COM file (Figure C).

I hope you will be able to answer my question about the clock-calendar problem I am experiencing, and that you find the additional information about line spacing on the DWII of some interest.

Clark J. Sprinkle
Summerville, SC

Cheers and jeers

To the Heath Users' Group and Sextant Publishing:

I am dismayed. I received in today's mail each of your magazines, and *TV Guide*. The *TV Guide* has a section in it called "Cheers and Jeers," and I feel I

(Continued on page 76)

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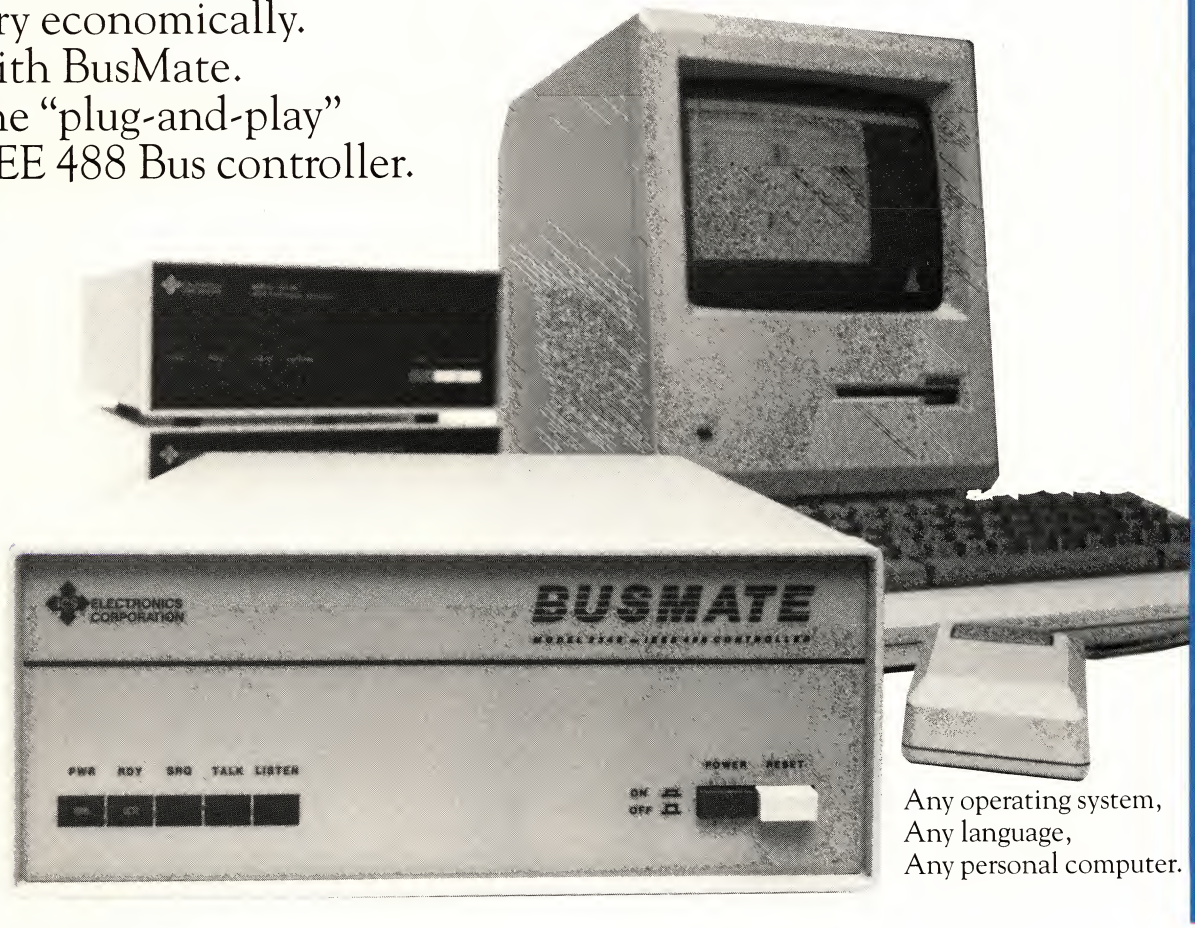

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New Life for the Z150 from Gate Arrays

Fancy, custom-designed sand castles are more impressive than boring silicon subdivisions with row after row of similar structures. The latter, however, do have redeeming consequences when you're trying to economize and avoid design delays. The Z148 and the history of its development demonstrate that sometimes less is more.

James C. Kunze

In the beginning, there was only sand on the beaches of California; then it was learned that sand made silicon and silicon made integrated circuits. Then the engineers flocked to California to be near the hallowed sand. There, they thought smaller and faster until they had invented the microprocessor. Then they made it smaller and faster yet.

One year they looked at what they had done, decided that it was good, and went to the beach.

Some of those engineers got too much sun. When they went back to work, they no longer thought small and fast. They thought of long beaches with little use and of modular homes, all alike, and packed together into bunches.

Those sun-crazed engineers invented the gate array, and marketing said it was very good. But all the other engineers sneered, and the inventors became outcasts.

The way we've always done things

Traditionally, integrated-circuit (IC) chips had been designed much like an ordinary electronic system. The designer decided what function was desired and then designed the transistor circuitry which would be required to do that function. Each sub-function was drawn as a schematic showing the transistors; then all the sub-functions were connected to create the device.

The required transistors were designed into the "substrate" of the IC. Here, different semi-conducting materials were sandwiched together to form the material of the individual transistors; as each layer of the substrate was put down, it was photographically etched. This process formed all the transistors in a desired arrangement. Then an interconnecting "mask" was placed over the top; this connected all the transistors into the desired circuits and connected the circuits' inputs and outputs to the external pins.

The emphasis had always been on making the transistors the smallest possible and arranging them to use the smallest amount of space—or "real estate"—on the substrate materials. Inefficient use of real estate was regarded as a sign of poor engineering. (Engineers who used up real estate were fired, or at least put in the back room where they couldn't do any damage.)

The business of gates

All digital logic is made up of groups of transistors which form logic "gates." These gates are connected in the mask to create the complex functions.

A basic gate has two inputs and one output. The output condition is either high or low and is determined by the state (high or low) of the two inputs. There are several types of basic gates, but the most versatile one is the NAND gate, which will have a high output unless both of its inputs are low. (Looking at it "numerically": two zeroes produce a one; a one and a zero produce a one; and two ones produce a zero.) Other gates would produce the other possible outputs.

The nice thing about NAND gates is that if they are connected together correctly, all other types of gates can be formed.

NAND gates are also used to form flip-flops. The most basic form of a flip-flop acts like a latch: a given input produces a continuous output which stays as it was set until the opposite input is received. Flip-flops are the basis for registers (memory devices, usually 8-bit), counters, and most other advanced types of logic.

Wasting real estate

The concept that the sundrenched engineers had was the "gate array." They would design a substrate where all the transistors would just be grouped into uniform, predetermined blocks of NAND gates. The mask to connect them would be designed separately.

That idea made them the outcasts of the IC design community. It violated the IC-chip designers' creed. These guys were designing an IC that would waste large amounts of real estate. Not all the gates could ever be connected together—and unused gates were an unthinkable waste of real estate!

The basic marketing concept of the gate array was to sell the idea of integrated circuits specially designed to perform exactly the functions that the customer wanted. Instead of selecting from whatever ICs were available, customers could design what they wanted.

Gate arrays use Very Large Scale Integration (VLSI) technology—which allows tens of thousands of gates to be designed and formed into the substrate. That means that large chunks of complex circuits can be placed on a single chip. This, in turn, means that a whole circuit card can be put into a single IC.

To make this possible, the IC manufacturer creates a "library" of existing computer circuits. This "library" is a computer file of the interconnection of gates that form an existing circuit. The "library" is part of a computer-aided design (CAD) system that knows how to interconnect any pattern of unconnected gates in the gate array to form the desired part.

James C. Kunze was the lead technical writer for computer service publications for Heath at the time that the Zenith '138, '148 and '158 computers were being designed.

A customer's engineers come to the IC designer's facility with a schematic of the circuit that they want put inside a single chip. The circuit is entered on the CAD system, which converts that circuit into an interconnecting photographic mask. With the mask, an integrated circuit can be manufactured that will do exactly what the customer desires.

Reducing costs

Designing a conventional integrated-circuit chip from scratch is a very costly procedure that can take several years of real time and many, many work years. Designing the circuit itself uses up relatively little time. The bulk of the time is spent in designing the substrate, the organization of the transistors in the chip.

The cost of designing the conventional IC substrate makes it prohibitive for most system manufacturers (defined here as anyone who makes anything electronic). Only chip manufacturers—who can spread the cost over all the system manufacturers—can afford it. The cost of producing any single IC chip is very small, only a few cents. Most of the price goes to offset the cost of design.

Using gate-array technology, the time involved is mainly that of designing the circuit. After that, designing the mask requires only about a worker month of additional time, plus the cost of using the CAD system. The system manufacturer pays a large lump sum up front and then pays about the cost of any other single IC chip.

From an IC engineer's point of view, gate-array chips are terrible. Gate arrays waste huge amounts of real estate. Only 60% to 80% of the gates can be used because of the way they must be interconnected. The speeds, moreover, while good, are not optimum. The spacing required for interconnection of the gates is slightly greater than normal to permit the interconnection scheme, lengthening the distance between circuit elements. Even at the speed of light, distance (even short distance) is time.

From the *systems* engineer's viewpoint, though, gate arrays are the best thing since sliced bread. Huge amounts of board real estate can be placed on a single chip. Cost is the yardstick that the systems engineer lives by. If only a few systems are to be built, the cost of developing a gate array is prohibitive; but if many systems are to be built, the development cost is more than offset by the cost of the ICs eliminated by the gate array.

Other costs are reduced also. If the number of cards is reduced, the amount of labor required to assemble the system is lowered. Also lowered is the cost of storing and distributing spare parts, and the cost of circuit cards themselves. The amount of time required to produce the system is also reduced—which has the additional advantage of increasing productivity.

All of those things make engineers into heroes—a state they like, especially at salary-review time.

And helping out other places, too

From a company standpoint, also, the gate array is a godsend. In these days of copying, anything that is based on readily available parts can be copied. If someone else can copy it, they can sell it at the same price—or even lower if they skimp somewhere else. When you design a gate array, however, the details of what is inside belong to you alone.

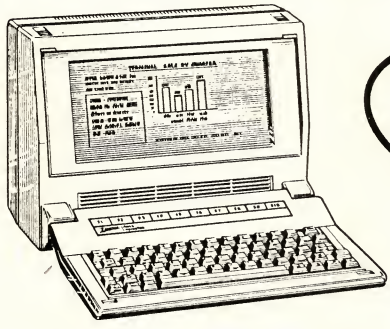
No one can copy your design because no one else has access to the details of what is inside the chip. Outside of corporate spying, the only information available from the gate array manufacturer about your chip is what is inside the unconnected version (useless information). The only other information about the chip is what you choose to tell your competitors.

(True, there are ways to take chips apart and unlock their secrets. Those ways are expensive, however. Fortunately, most pirates are cheapskates.)

Gate arrays have an additional advantage for the marketing department.

Marketing always fights for more features than the other guy has—right up until it increases cost. In conventional designs, everything that increases function also increases cost; so, the very people who scream for more performance cut it out on the grounds of cost.

When a gate array is used, however, more functions come absolutely free. You are already committing yourself to the expense of a design; so, it is only a little more expensive to add features. And that expense is a one-time-only cost; when spread over the production life of the system, it becomes unmeasurable in the per-unit cost.



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Circle #190 on Reader Service Card

On the beach in Benton Harbor

The gate array made possible the latest line of Heath/Zenith computers. It was the gate array's uniquely small size and relatively low cost that made the new computers—the Z138, '148 and '158—possible.

While the chip engineers were basking in the California sunshine, the marketing people at Heath/Zenith were afraid that *they* were about to experience the beach's sunshine. It may be pleasant on California beaches in December; but the prospect of spending the winter on the beaches of western Michigan is not too nice.

The marketing people at ZDS were going at full speed. They wore the Zenith white hats, having just expanded the sales of the parent company more than any other division. But they saw storm clouds forming over Lake Michigan. The computer wars were in full force in mid-1984.

A price war was going strong. The retail cost of computers was coming down rapidly and alarmingly. Profit margins were becoming slimmer and slimmer. Everyone who could was building an IBM-compatible computer, and some manufacturers were cutting the margins to the bone. The consumer was exposed to a very broad choice, and it was not all in Zenith's favor.

Most consumers saw IBM as the best name in computers and all others as less than the ideal. If Zenith could not compete from a name standpoint, they had to compete from a dollar perspective, and they were losing.

The marketing department needed both a cost advantage and new improvements that would make selling the units easier. This combination is what research and development departments fear. The two goals, lower cost and better performance, are usually totally opposed.

It was cost that initiated the design effort for the Z158 computers. The situation would soon be desperate. Very soon it would be impossible to sell computers for a profit. Without profit, a company soon dies. It was necessary to find a way to reduce the cost of building a computer. While more performance was desired, it was cost that would kill in the consumer market.

In searching for the solution for marketing, the engineering department came up with the gate array. The cost advantages were staggering. The engineers were given white hats, but no time on the beach. They had to implement their idea and do it quickly. There would be no time to waste on beaches or even sitting at home with spouse and offspring. Speed was everything.

Because of the high initial costs of developing gate arrays, the cost of components would not be significantly changed for the first year of production. Real savings would be seen in the other aspects of the gate array.

Bringing gate arrays to the '150

The design of the new computer was to be based on the design already being used in the Z150, Zenith's first computer to be completely compatible with the IBM Personal Computer. The initial idea was to combine as much of the current design into the smallest number of gate arrays possible. The initial hope was to move everything onto a single circuit card, the same size as one of the Z150's four circuit cards.

Some things don't come on gate arrays, however, such as memory and driver circuits and the central processing unit (CPU). That meant that the circuit would still be larger than a single circuit card. Also, the amount of logic that could be put into a single gate array meant that the design would need at least two circuit cards.

The sensible way to cut the four cards down to two was to combine the related functions of the random-access memory (RAM) and CPU cards onto a single circuit card, and to combine the functions of the floppy-disk controller card and the video-logic card onto the other card. Most of the logic functions for each card would be taken over by a gate array. Each gate-array chip would be installed on its circuit card in the same manner as any other integrated circuit; the only difference would be the socket that would hold the chip.

The cost advantage was in the combination of the video-logic card and the floppy-disk controller card. Priority went to perfecting that gate array and that circuit card—although both gate arrays would be designed more or less at the same time.

The first gate array to be available would combine all the logic of the floppy-disk controller and video-driver cards. (Internally at Heath/Zenith, this gate array was referred to as the video/floppy circuit.)

As originally conceived, the video/floppy circuit card would be used in the Z150 series of computers to reduce the card count inside the computer from four to three. This computer would be an interim product to reduce the cost of the Z150 computer; it would be referred to as the Z152.

Going to a three-board design would mean a significant savings in the cost of bare printed-circuit cards. Not only would the number of cards be reduced, but the resulting card would be much simpler (therefore cheaper). Labor costs would be reduced in production and in the automatic test equipment (ATE) department. However, the video/floppy gate-array chip would not provide much, if any, performance advantage. In short, it was a company favorite but offered little to the consumer.

The price had to come down to sell any computers, so the question of any advantage to the consumer was moot. Would it

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be possible to lower the price more or just ease the corporate pain?

Operation of the computer with the three-card system would remain the same. The computer would function exactly the same with three cards in it as it had with four cards.

The CPU/RAM card

The second proposed gate-array chip would be used to replace much of the circuitry on the CPU card and on the memory card. (This chip was internally referred to as the CPU/RAM chip.) The combination of the two new cards (each card with a single gate array) would create the Z158 computer.

The CPU/RAM card made little impact on the final price, replacing fewer expensive components than the video/floppy gate array. But it was possible to add performance at no extra cost by using an 8-megahertz CPU, and the gate array could provide for switching from 5 to 8 MHz at very little or no extra cost.

The three-card Z152 would lower the production costs of the computer, but would not change anything about the system from a user standpoint. With two cards, the design of the Z158 made a much smaller impact on the cost of the computer; but it would allow the user to select between the usual (IBM-decreed) CPU operating speed of 4.77 MHz and almost double that speed.

In *most* cases, the extra speed causes no change to the compatibility of the system. It is possible, though, that increasing the speed of the CPU could throw off the compatibility of the system. Assembly-language programs that use clock-derived signals for real time would be messed up. Systems that use data-acquisition devices designed for the slower speed could be in real trouble. It was therefore necessary to allow the user to choose the speed desired. In most cases, however, choosing the higher speed increases the operating speed of the system with no adverse effects.

(Before you start to think that doubling the clock speed doubles the processing speed of the system, remember that much of the time involved is fixed. Doubling the speed of the clock doubles the speed that data moves through the CPU. However, the same amount of time is required to read from or write to a disk drive. As well, memory has fixed minimum times for operations—which means that the time can be shortened for a memory operation, but usually not halved. The result is shortened—but not halved—times for overall operation.)

Dealing with jr.

At about the same period of time that the Z152/Z158 computers were being conceived, the marketing department at Zenith Data Systems decided that they needed a product to compete with IBM's PC jr. Marketing passed the edict to the ZDS engineering department that they needed the cheapest possible IBM-compatible design. Marketing wanted a product which would be able to compete on a dollar basis with the jr. but would have significant advantages: the improved keyboard of the Z150, and full compatibility with the IBM PC.

The engineering department looked at the new proposal and interpreted the directive to mean that they were to produce the most inexpensive computer possible from a components standpoint. Already on the burner were the two related products—the three-card Z150 using the video/floppy gate array (the Z152), and the two-card Z150 using both the video/floppy gate array and the CPU/RAM gate array (the Z158).

The gate arrays used in these two projects were scrutinized by the engineering department. The video/floppy gate array had a number of advantages. It would be available in quantity in the time frame required. It would also provide the most cost effectiveness, because more expensive components would be replaced. The CPU/RAM gate array did not share the advantages: it would be available six months after the video/floppy, too late to meet the time requirements; also, the component savings were marginal.

Based on work for the other two projects, engineering proceeded with a design for the jr. competitor. The design was firmed up just before Christmas of 1984. It would be called the Z140 (eventually, the Z148), and it would be a large single-card computer. There would be no possibility for expansion. This design gave the lowest possible cost for components that could be achieved in the time frame required. Much of the development costs of the gate array were written off to the three-board Z152 project.

The only question remaining was the priority between the Z152 and the new Z140 computers for the use of the video/floppy gate array. Both projects needed the chips.

Conference time

A meeting was called by engineering. Present were representatives from engineering, manufacturing, marketing, ATE, quality control, publications, and management of both ZDS and Heath. All aspects of the project were to be discussed before the design was finalized.

ATE expressed major doubts about the cost of the single board. While the component cost was lowest for a single board, there were problems with the size of the test jigs, and with the cost of scrap resulting from a single board. The manager of engineering gave the approximate cost in components (extra buffers, connectors, and wiring) required to split the single card into two.

A two-card design suggested advantages to the marketing group. It meant that the bus was split out. If it was split out, a "Y" connector could be built to accommodate expansion. Also, for very little cost they could add the 8-MHz capability of the Z158.

The goal was still to produce the cheapest possible computer, but the costs of manufacturing and testing had to be considered. The design was put on hold for a short time while the manufacturing, testing, and scrap costs were examined.

During the following week, the design effort was split. The problems of the two-card system were analyzed in more depth. Work proceeded on the single-card design, but the two-card design was also pursued.

The CAD system had no difficulty in inserting the required components into the existing data for the single printed-circuit card design. In less than a week, there were masks for three cards: the single-card computer, and both of the cards for the two-card system. All that was needed was the decision.

At the next meeting, the costs of the two designs were discussed; it was decided that the cost of manufacturing and scrap exceeded the component savings for the single-card system. Marketing's eyes lit up with new prospects. Now they not only had the cheapest possible computer, but one which could be expanded. That meant that they could sell not only computers, but also expansion components. But wait, what would that do to sales of Z150s? The decision was made to proceed with manufacturing plans for the two-card Z140 and the expansion box on a tentative basis.

Packaging it

The last of the decisions was packaging. The ideal was a plastic cabinet (cheapest and most easily formed into an attractive package); but they still had to ensure that the unit did not emit significant radio-frequency interference (RFI).

The problem was to stop RFI not just in the lab, but to do it in manufacturing as well. It was easy to attach aluminum foil to the inside, even bond it into the plastic. The lab could easily make the bond good enough to pass the initial tests, but could manufacturing consistently seal the boxes? Some preliminary plastic boxes were ordered to test the concept.

Marketing began to design the case from plastic. The box itself was a marketing function, although the considerations of cooling and RFI were an engineering function. The protocol was for marketing to design the shape but for engineering to be able to modify or even reject the configuration if cooling or RFI became a factor.

Most of the pieces fell into place easily. The plastic box could work. Snap-in circuit-card holders could be used to lessen the cost of manufacturing (final

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assembly).

The Z140 was working by January of 1985, less than four months after its conception. Ten of the initial fifty test video/floppy gate arrays were diverted into preproduction tests of the Z140.

The design was frozen in the first week of January 1985. That meant that no circuit changes could be made to the computer. Changes in packaging were possible but not recommended after that date.

Putting it out the door

If the design was frozen then, why did it take almost a year to deliver the first ones to users? The answer is the manufacturing process.

It would take six months to develop a program for the ATE that would isolate a single component failure quickly and precisely. That capability is necessary to a production line. Sick computers cannot hold up the flow of systems from the production line to the test facility. Computers cannot jam up the hallways waiting for special test work. It must be possible to find and fix bad parts or verify the operation of computers almost instantly.

It also takes time to develop and produce the program for the equipment that will do the automatic insertion of components into the circuit board. It takes time to plan the production and schedule it into the flow of existing products. It takes time to prove the product—and the smallest change in hardware starts the whole process over again.

It took less than four months to design the Z140, and over a year to put it into production and deliver it (as the Z148) to the store shelves. That is really a very short time.

I left Heath just after the finalization of the designs of the new computers. To my knowledge, no Z152 computers were produced. (It was intended to be only a short-term computer, anyway.) The first lot of production video/floppy gate arrays were diverted into the Z140 program. The video/floppy gate array was used in the Z158 when the CPU/RAM gate arrays became available.

And there you are

The new computers are a marvel of technology, utilizing the latest in technology to produce not only a cheaper, but a better product—a product with more features for the dollar than anything before. These computers have more bang for the dollar.

My hat is off not only to the designers of the new computers, but to those engineers on the California beaches—the ones the rest of the world thought had gotten too much sun. △

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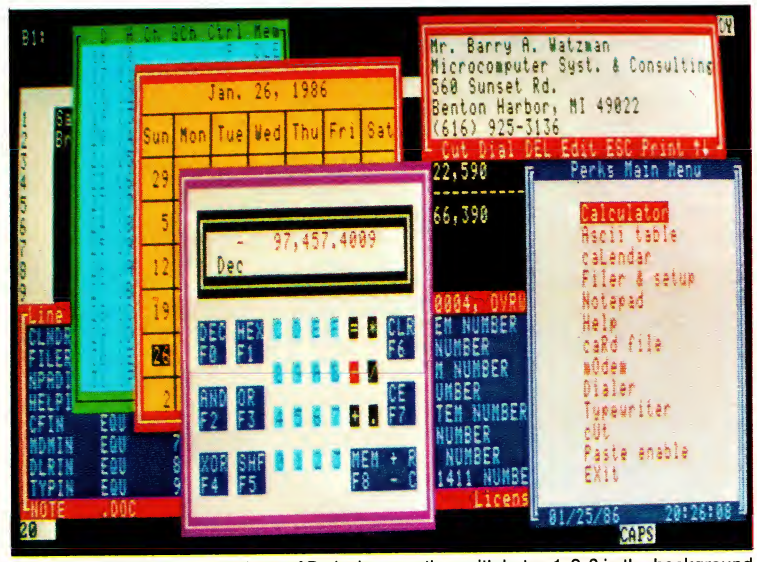

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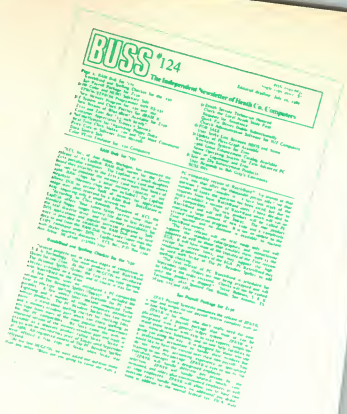
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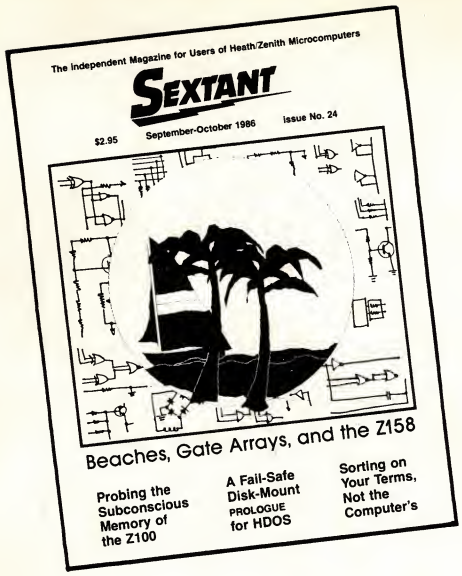
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Probing the Subconscious Memory of the Z100

Here's what you need to know to start exploring up to 74K of RAM Zenith didn't intend you to use.

Gary R. Cramblitt

Did you know that a monochrome Z100 has at least 10,000 bytes of memory that is never used?

If you have color capability with 32-kilobit video memory chips, you have 38,000 bytes of memory just waiting for you to write a program in order to exploit it. And if your Z100 has 64-kilobit video memory chips, your computer has at least 76,000 bytes of memory that is never used. This article will tell you how you can make use of this hidden resource.

What? You don't know what kind of video memory chips you have?

Easy. Just turn on your computer; if auto-boot is enabled, press DELETE before it can boot from disk. You should see a little "hand" prompt. Now press the "S" key; the Z100's monitor program will tell you whether you have color capability, what size memory chips are installed, and the size of your random-access memory (RAM).

The unused memory is, of course, part of the video memory. The video memory contains the image appearing on the screen of your Z100. However, there are parts of this video memory that are never displayed. I call them the "subconscious" memory of the Z100. You can use these regions for whatever purpose you wish—although I'll present some guidelines you should try to stick to.

You must be *very* careful when using the undisplayed regions of video memory I'll describe. If you are not careful, you could easily corrupt your screen image, or worse, crash the system. Also, there are several complications you must be aware of to use this memory. I'll explain shortly.

My Z100 has version 2.5 of the monitor routines stored in read-only memory (ROM). At the monitor's hand prompt, use the "V" command to find what version of the ROM you have. The video memory is under direct control of the monitor ROM, and there is no guarantee that other ROM versions will behave exactly like version 2.5. If you have a different version, you will have to experiment to determine if it is different enough to cause a problem.

Gary R. Cramblitt is employed by IIT Research Institute in Annapolis, Maryland, where he specializes in user-friendly software interfaces and programmer tools. He says, "There aren't enough hours in the day, so I'm trying to find a way to put my computer on my windsurfer."

The Z100's video memory

The key to using the subconscious memory is understanding how the Z100's display works.

The Z100 will display 25 rows of 80 characters each. Look at Figure 1, which shows a portion of the topmost character

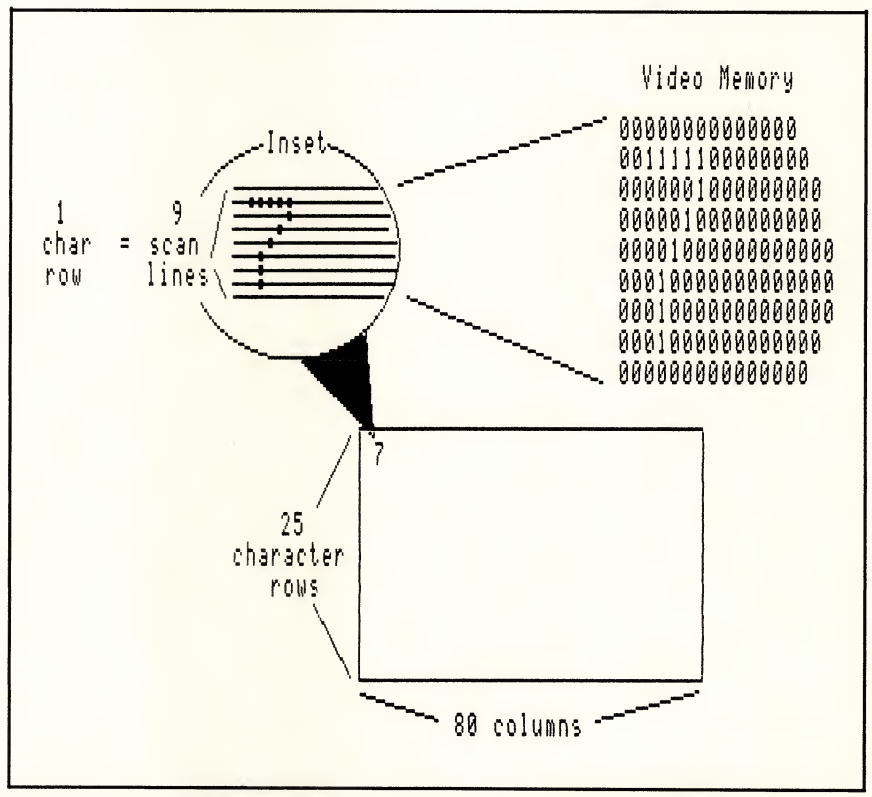

Figure 1. A portion of the topmost character row of the screen of the Z100 is shown in detail. Each of the 25 character rows is formed from nine horizontal scan lines. A dot on the screen corresponds to a single bit of video memory.

row of the screen and the corresponding video memory that produced the image.

To form the character row on the Z100, the electron gun in the cathode-ray tube (CRT) scans horizontally across the screen nine times. For each scan line, the Z100 reads 80 bytes of video memory. For each bit that is a 1 in the memory, a dot on the screen will be turned on. For each 0 bit, a dot will be turned off. (With eight bits to a byte, we get 640 dots per line.) You can see that the Z100 reads nine lines of 80 bytes each to display one character row on the screen.

The Zenith engineers made it easy for the monitor ROM to move characters into the video memory. At the end of each 80-byte row of memory, they defined 48 bytes of memory that are not displayed. Hence, each scan line on the CRT actually begins at a multiple of 128 in memory. 128 is a nice power of 2, so you can multiply a binary number by 128 just by shifting it seven places to the left. And the Z100's 8088 central processing unit (CPU) has bit shifting as one of its built-in instructions; so it's not necessary to write any extensive programming code to do the job. With a simple instruction, then, the ROM routines can quickly calculate the starting location for a scan line simply by using fast bit shifts.

Aha, you say. We can use these extra 48 bytes at the end of each scan line for our own purposes.

Well sorry, but no, you can't. The hardware on the Z100's video board assigns the actual memory bits to other addresses. Since the Z100 "maps" these memory addresses elsewhere, it would corrupt some other portion of the display if you were to store anything in them. (Understanding where they are mapped is not important. You just can't use them.)

For 32-Kilobit Video RAM Chips

When n is between	Use this color plane	Subtract from n
0 and 9,999	green	0
10,000 and 23,999	red	10,000
24,000 and 37,999	blue	24,000

For 64-Kilobit Video RAM Chips

When n is between	Use this color plane	Subtract from n
0 and 19,999	green	0
20,000 and 47,999	red	20,000
48,000 and 75,999	blue	48,000

Table 1. Using this table, you can look up which color plane to use for the byte value (n) whose offset you would like to calculate. The value in the right column is subtracted from n, then the rest of the algorithm is followed as described in the text.

Finding the leftovers

Another thing the Zenith engineers did was start each character row at a memory location that is a multiple of 2,048 (2^{11}). Again, this makes it possible for the ROM character-display routines to quickly calculate the start of each character row using bit shifts. Now, as I've said, each character row is 9 scan lines of 128 bytes each (80 displayed bytes plus 48 non-displayed bytes). But 9 times 128 is only 1,152. And 2,048 minus 1,152 leaves 896 bytes left over.

We're getting warm!

Look at Figure 2, which shows one character row of memory. The area in the upper left is the nine scan lines of 80 bytes each that are displayed. The area at the right is the 48 bytes at the end of each scan line that are "mapped" to other regions of memory.

The area at the bottom consists of seven scan lines of 80 bytes each, or 560 bytes. We can use these bytes. Well, almost.

If we number the scan lines 0 through 15, as was done in Figure 2, we can say that scan lines 0 through 8 are displayed. Scan lines 9 through 15 are not displayed.

If your computer has color capability, then you have three planes of video memory—one for green, one for red, and one for blue. If you have a monochrome system, only the green plane is present.

It turns out that in the green color plane, the monitor ROM routines use scan lines 9 and 10 to store information about the characters on the screen. (I'll explain exactly what information shortly.) This leaves scan lines 11 through 15 of the green color plane for our use.

The monitor ROM routines don't use scan lines 9 and 10 for anything special in

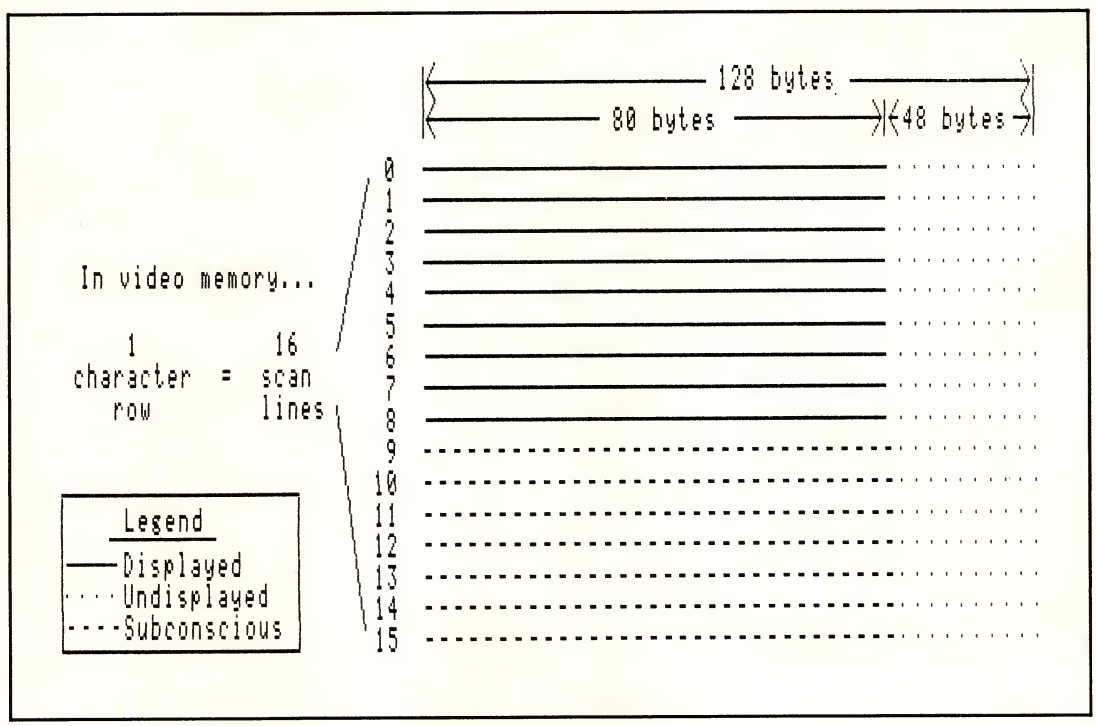

Figure 2. The memory layout for a single character row. Only the first 80 bytes of scan lines 0 through 8 are displayed on the screen. The last 48 bytes of each scan line are not displayed. The "subconscious memory" is scan lines 9 through 15.

the red and blue planes; so you can use scan lines 9 through 15 in these planes.

In summary, you can use scan lines 11 through 15 of the green video plane, and you can use scan lines 9 through 15 of the red and blue planes if you have color capability.

The Z100 will display 25 character rows. There are five "subconscious" scan lines per character row in the green plane, so that makes a total of 125 scan lines available for our use. Each scan line is 80 bytes; that means we have 80 times 125, or 10,000 bytes of available unused memory in the green plane.

If your computer has color capability, you have three planes of memory, and that makes 38,000 bytes of available memory, assuming you have only 32-kilobit memory chips. If you have 64-kilobit video memory chips, your computer uses only half of the video memory at a time. So (even if your programs are doing "bank switching"), there's a total of 76,000 bytes of undisplayed video memory in these computers!

Using the subconscious memory

To use a byte of the subconscious video memory in your Z100, you must first calculate the location of the byte. The calculations follow directly from the video memory scheme I've described. The following algorithm will calculate the offset from the start of video memory for the nth byte of subconscious memory. (The first byte is byte 0.)

1. Before proceeding with the algorithm, use Table 1 to find which color plane to use for the value of n selected, and to adjust the value of n. (Note that values are mapped differently for 32-kilobit and 64-kilobit video memory chips.)
2. If the green plane will be used, calculate n/400 and set aside any remainder. If the red or blue planes will be used, calculate n/560 and set aside any remainder. This gives us the character row where the byte is located. For example, if n is 885, then the character row is 2 in the green plane, and the remainder is 85.
3. Divide the remainder obtained in step 2 by 80. Again, set aside the remainder. If the green plane will be used, add 11 to the quotient to get the scan line within the character row. If the red or blue planes will be used, add 9 to the quotient to get the scan line within the character row.

In our example, 85 divided by 80 is 1 with remainder 5. And 1 plus 11 gives scan line 12. The remainder is the byte within the scan line—in the example, byte 5 of scan line 12.

4. Multiply the character row obtained in step 2 by 2,048. Add this to the scan line obtained in step 3 multiplied by 128. Add the remainder from step 3.

In our example, 2 times 2,048 is 4,096; 12 times 128 is 1,536; 4,096 plus 1,536 plus 5 is 5,637.

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The number produced by the calculations above is the memory offset within the color memory plane. The green memory plane begins at address 0E0000 hex, the red plane starts at 0D0000 hex, and the blue plane starts at 0C0000 hex.

In our example, the 858th byte was offset 5,637 in the green plane. So, the following Z-BASIC statements will store the uppercase letter "A" (decimal value, 65) at that byte location.

```
DEF SEG = &HE000
POKE 5637,65
```

Before we can store the byte, however, there are some things we must do.

Accessing video memory

There are two microprocessor chips in the Z100 that need to access video memory. The 8088 central processor is one. The other is a device called the CRT Controller. It is responsible for reading the video memory to produce the video signal sent to the CRT screen.

The Z100 will not allow us to read or write to the video memory unless we've modified some bits in a Z100 control port called the video control register (VCR). The VCR controls access to the video memory. The upper four bits of the VCR control the 8088 CPU's access to the video memory. The lower four bits control the CRT Controller's access to the video memory.

Since it is the 8088 CPU which stores our data in the video memory, it is the upper four bits of the VCR that concern us here. Before storing a byte of data in the video memory, we must clear the VCR's bit 7 (the most significant bit) to zero. This permits the 8088 to store or retrieve data from video memory.

The next three bits of the VCR each control a color plane which the 8088 can modify when storing data. To make things simple, we will always set these bits to 1. (If a bit were zero, then a byte written to any other plane would also be written to the plane governed by that bit.)

Whenever any program that modifies the video control register is finished, it should always restore the VCR to its original value. To do this, you begin by reading the VCR and storing its value in a variable somewhere; then modify the bits of the VCR you want changed. When you're finished accessing video memory, you can restore the original value of the VCR from the variable.

When you modify the bits of the VCR, be sure not to change the lower four bits. We can modify the bits of the VCR by performing bitwise logical ANDs and ORs. Protect bits 0-3 by ANDing them with 1's—if we take a 1 or 0 and AND it with 1, we will produce the original value. Set bits 4-6 to 1 by ORing them with 1's—if we take a 1 or 0 and OR it with 1, we will produce a 1, regardless of the original value. And clear bit 7 by ANDing it with 0—if we AND the original with a 0, then we will produce a zero, regardless of the original value. ANDing the entire byte with 7F hexadecimal (0111 1111) and ORing it with 70 hexadecimal (0111 0000) will do the trick.

The following Z-BASIC code fragment reads the video control register, saving its value in variable VCRSAVE so that the VCR can be restored to its original value. Next, bit 7 of the VCR is cleared, and bits 6, 5, and 4 of the VCR are set. Bits 3 through 0 of the VCR remain unchanged.

```
VCRSAVE = INP(&HD8)
OUT &HD8,VCRSAVE AND &H7F OR &H70
```

Important pointers

To make scrolling on the screen operate very quickly, Zenith engineers designed the Z100 so that the hardware doesn't have to move large amounts of data in memory. Whenever the screen scrolls one line, the Z100 needs only to modify a pointer to the start of the screen instead of moving all the data in video memory.

Zenith didn't intend you to use the subconscious memory of your Z100.

To scroll the screen up one line, the pointer is advanced one line. What was the second line of the screen becomes the first line. What was the third line of the screen becomes the second line, and so on down the screen.

Both the 8088 CPU and the CRT Controller need to access video memory. The Z100 engineers designed the hardware so that each had its own pointer to the first line of the screen.

The CRT Controller's pointer is called the Start Address Register. The pointer for the 8088 CPU is called the Address Latch. Normally, both point to the same line of video memory. But they don't have to!

Although the Start Address Register affects what you see on the screen, the Address Latch affects only what the 8088 CPU sees in memory. It's possible for the 8088 Address Latch to say that the first line of the screen is what you see as line 20.

Normally, the two pointers agree and are kept synchronized by the ROM monitor routines. This can present a problem to any program we might write that wants to use the subconscious video memory.

Why? Consider the following sequence of events:

1. Our program stores a byte in the subconscious memory of character row 2.
2. The screen scrolls up one line. The ROM routines advance the Start Address Register and the Address Latch one line.
3. Because the ROM routines have modified the Address Latch, our data is no longer in character row 2. It is now in character row 1.

Our program must "chase" the data as the screen scrolls. This would be a distinct pain. Indeed, it would be practically impossible to keep track of the screen scrolling going on. But there's a much easier way.

I've said that the Address Latch doesn't affect what we see on the screen of our CRT. That means we can change it without any visible effects on the screen—so long as we set it back again before any program changes the display in any way.

The Address Latch is an eight-bit register at port address DA (hexadecimal). An explanation of what this register contains is rather complicated. For our purposes, we only need to know how to read and set it.

Before our program begins storing any data in the subconscious memory, it must read and save the Address Latch. Let's call this saved value the Base Pointer. Later, before accessing the video memory again, our program should read and save the *current* value of the Address Latch, temporarily set the Address Latch to the Base Pointer, access the subconscious video memory, and then restore the Address Latch to the saved value. In this way, from our program's point of view, the screen never scrolls.

For example, at the start of our program we have the following Z-BASIC statement to read the Address Latch and save its value in the Base Pointer variable:

```
BASEPOINTER = INP(&HDA)
```

Later in our program, before reading a byte of the subconscious memory, the following statements will read and save the current Address Latch, then set it to the Base Pointer:

```
CURRENTLATCH = INP(&HDA)
OUT &HDA,BASEPOINTER
```

After reading the wanted byte of subconscious memory, the Address Latch is restored with the following statement:

```
OUT &HDA,CURRENTLATCH
```

In summary, any program that will use the subconscious memory of the Z100 must begin by reading and saving the Address Latch at port DA hex. Call this saved value the Base Pointer. Then, to read or store byte n of the subconscious memory, the following steps are used:

1. Calculate the color plane and offset as I've described above.
2. Read and save the video control register at port D8 hex. Clear bit 7 and set bits 6, 5, and 4 of the VCR. Leave bits 3 through 0 of the VCR unchanged.
3. Read and save the Address Latch at port DA hex. Set the Address Latch to the Base Pointer.
4. Read or store the byte. Remember to set the correct segment address for the color plane calculated in step 1.
5. Restore the Address Latch to the value

saved in step 3.
6. Restore the video control register to the value saved in step 2.

Scan lines 9 and 10

I've said that the monitor ROM routines use non-displayed scan lines 9 and 10 of the green video plane for a special purpose. What is stored there?

Scan line 9 contains, in effect, the character displayed on the screen. Actually, what is stored is an index to the font table; but simply adding 32 will give you the equivalent ASCII code for the character. Naturally, if graphics are being displayed on the screen, scan line 9 is meaningless. Scan line 9 is useful if you want to dump the text of the screen to a printer.

Converting a screen row and column number into a memory offset in the green video plane is similar to the subconscious memory calculation we've already seen. To calculate the scan line 9 memory offset for row r and column c, use the following formula:

offset = ((r–1) * 2048) + (9*128) + c

Row numbers range from 1 to 25, and column numbers range from 1 to 80.

Scan line 10 contains information regarding the color and video attributes of the character being displayed. The bits are defined as follows:

Bit 7: 1 if character is displayed in reverse video.
Bit 6: Not used.
Bit 5: 1 if background is displayed with green color component.
Bit 4: 1 if background is displayed with red color component.
Bit 3: 1 if background is displayed with blue color component.
Bit 2: 1 if character is displayed with green color component.
Bit 1: 1 if character is displayed with red color component.
Bit 0: 1 if character is displayed with blue color component.

For example, if a character is displayed as blue on a white background, bits 5, 4, and 3 (white background) and bit 2 (blue foreground) will be 1.

The following formula will calculate the scan line 10 memory offset into the green video plane for a character at row r and column c:

offset = ((r–1) * 2048) + (10*128) + c

A demonstration

The Z-BASIC program in Listing 1 demonstrates using the subconscious memory. It begins by saving the current screen into the subconscious memory. Later, at the request of the user, this saved screen is redisplayed.

In the interest of clarity, the program closely matches the algorithms I've described. It is quite slow, but can easily be speeded up if you understand the principles involved.

For example, when saving the screen,

Listing 1. A Z-BASIC program which demonstrates the use of the Z100's subconscious memory. The program stores the current screen into subconscious memory, then redisplays it when directed to do so by the user.

```
1000 '      A demonstration program for the subconscious video memory
1001 ' of a Z100 by Gary Cramblitt.
1002 '
1003 '      This program begins by saving the visible text of the
1004 ' screen into the subconscious memory.  When the user is ready,
1005 ' the screen is obtained from the subconscious memory and
1006 ' and redisplayed back onto the screen.
1007 '
2000 ' *** Read and save the initial Address Latch value
2010 BASEPOINTER = INP(&HDA)
2015 BANKS = 1                  ' Change to 2 if you have 64K parts
2020 ' *** Save the visible text of the screen and put it into
2030 '     the subconscious memory.
2040 GOSUB 50000
2050 ' *** Now prompt and get user response.  When they are ready, they
2051 '     will enter an "X", whereupon the program will retrieve the
2052 '     stored screen from subconscious memory and redisplay it.
2080 PRINT "Press <RETURN> a few times.  When you are ready,"
2090 INPUT " enter an X >",CH$
3000 IF CH$ <> "X" THEN GOTO 2080
3010 GOSUB 60000
3020 STOP
3030 '
3031 ' **********  SUBROUTINES  ***********
3032 '
10000 ' *** This routine calculates the memory offset and color plane
10010 '     for the Nth byte of subconscious memory.  On entry, variable
10020 '     N contains the Nth byte of subconscious memory.  On exit,
10030 '     variable OFFSET contains the computed memory offset, and
10040 '     variable COLORSEG contains the base address of the color
10050 '     plane.
10060 '     Notice backslashes (integer division) operators in statements
10070 '     appearing in this routine.
10071 '
10072 ' Start by computing the color plane to be used.
```

→

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```
10100 COLORSEG = &HE000: SCANLINE1 = 11
10101 IF N < (BANKS*10000) THEN GOTO 10200
10110 COLORSEG = &HD000: SCANLINE1 = 9
10111 IF N < (BANKS*24000) THEN N = N - (BANKS*10000): GOTO 10200
10120 COLORSEG = &HC000
10121 IF N < (BANKS*38000!) THEN N = N - (BANKS*24000): GOTO 10200
10130 PRINT "N too large in subroutine at 10000.  Not that much"
10140 PRINT "subconscious memory is available.  N = ",N
10150 ' Calculate the number of subconscious bytes per character row.
10200 BYTES.PER.ROW = (16 - SCANLINE1) * 80
10210 ROW = N \ BYTES.PER.ROW                    ' Calculate character row
10220 LEFTOVER = N MOD BYTES.PER.ROW             ' Remainder
10230 SCANLINE = (LEFTOVER \ 80) + SCANLINE1     ' Calculate scan line
10240 SCANLINE.BYTE = LEFTOVER MOD 80            ' Byte within scan line
10250 OFFSET = (ROW*2048) + (SCANLINE*128) + SCANLINE.BYTE
10900 RETURN
10901 '
20000 ' *** Store a byte into the subconscious memory.
20010 '     Stores the byte in variable CH into the subconscious
20020 '     memory location at offset OFFSET within color plane
20030 '     COLORSEG.  The subconscious memory begins at BASEPOINTER
20040 '     of each color plane.
20100 CURRENTVCR = INP(&HD8)                     ' Get video control reg
20200 CURRENTLATCH = INP(&HDA)                   ' Get address latch
20300 OUT &HD8,CURRENTVCR AND &H7F OR &H70       ' Set VCR to enable access
20400 DEF SEG=COLORSEG                           ' Set proper color plane
20401 ' Set the Address Latch in case any screen scrolling has occured
20500 OUT &HDA,BASEPOINTER
20600 POKE OFFSET,CH                             ' Store the byte
20700 OUT &HDA,CURRENTLATCH                      ' Restore address latch
20800 OUT &HD8,CURRENTVCR                        ' Restore VCR
20900 RETURN
20901 '
30000 ' *** Retrieve a byte from the subconscious memory.
30010 '     Retrieves the byte at offset OFFSET of color plane
30020 '     COLORSEG.  Subconscious memory starts at BASEPOINTER
30030 '     within each color plane.  The byte is returned in
30040 '     variable CH.
30100 CURRENTVCR = INP(&HD8)                     ' Get video control reg
30200 CURRENTLATCH = INP(&HDA)                   ' Get address latch
30300 OUT &HD8,CURRENTVCR AND &H7F               ' Set VCR to enable read
30400 DEF SEG = COLORSEG                         ' Set proper color plane
30401 ' Set the Address Latch in case any screen scrolling has occured
30500 OUT &HDA,BASEPOINTER
30600 CH = PEEK(OFFSET)                          ' Read the byte
30700 OUT &HDA,CURRENTLATCH                      ' Restore address latch
30800 OUT &HD8,CURRENTVCR                        ' Restore VCR
30900 RETURN
50000 '
50001 ' *** Use scan line 9 of the green video plane to obtain
50002 '     the current text of the screen.  Save the screen into
50003 '     the subconscious memory.  This routine is not very
50004 '     efficient.  It is intended only to demonstrate the basic
50005 '     algorithm.
50010 N = 0                                      ' Start with 0th byte
50011                                            '  of subconscious memory
50012 PRINT "Saving screen.  Takes a few minutes.  Please wait..."
50015 CURRENTVCR = INP(&HD8)                     ' Get video control reg
50016 OUT &HD8,CURRENTVCR AND &H7F               ' Set VCR to allow read
50020 FOR LYNE = 0 TO 23                         ' 24 lines on the screen
50030 FOR COLM = 0 TO 79                         ' 80 bytes per line
50035 DEF SEG=&HE000                             ' Set to green color plane
50040 CH = PEEK((LYNE*2048)+(9*128)+COLM)+32     ' Obtain screen character
50041 GOSUB 10000                                ' Calc next subconsious
50042 GOSUB 20000                                '  memory slot and store
50043 N = N + 1                                  ' Advance to next slot
50050 NEXT COLM
50070 NEXT LYNE
50080 OUT &HD8,CURRENTVCR                        ' Restore VCR
50085 PRINT "Screen has been saved and stored in the subconscious memory."
50090 RETURN
60000 '
60001 ' *** Retrieve the saved screen from subconscious memory and
60002 '     redisplay it on the screen.  Cursor is left at row 21.
60003 '
60010 N = 0                                      ' Start with byte 0
60011 LOCATE 1,1                                 ' Home cursor
60020 FOR LYNE = 0 TO 23                         ' 24 lines to the screen
60030 FOR COLM = 0 TO 79                         ' 80 bytes per line
60041 GOSUB 10000                                ' Calc subconscious memory
60042 GOSUB 30000                                '  loc and retrieve byte
60043 N = N + 1                                  ' Advance to next slot
60044 PRINT CHR$(CH);                            ' Display retrieved char
60050 NEXT COLM                                  ' Next char of row
60060 PRINT                                      ' End of row
60070 NEXT LYNE
60080 LOCATE 21,1                                ' Put cursor near bottom
60090 RETURN
```

it isn't necessary to save and restore the Address Latch and VCR for every byte stored in the subconscious memory. Since nothing new is being displayed on the screen, these steps need to be done only once.

An equivalent assembly-language program can save the screen in about a second.

Guidelines for using the subconscious memory

Zenith didn't intend you to use the subconscious memory of your Z100. You must be aware that its contents are extremely volatile. Your data could be erased at any time.

For example, any program which erases the screen is likely to erase the subconscious memory also. Likewise, a program that modifies video memory directly might also destroy the subconscious memory.

So, here are some suggestions on how to avoid problems using the subconscious memory.

1. Don't save anything in the subconscious memory that you can't afford to lose.
2. Store data in the subconscious memory only briefly. It is best used as a temporary scratch area.
3. Avoid using resident or background programs with your programs that use the subconscious memory. On-line notepad programs, for example, are likely to modify it.
4. Avoid using the subconscious memory with any program that bypasses the ROM routines and modifies the video memory directly. Graphics editing programs, for example, typically work directly on the video memory. They're likely to erase any data you have stored in the subconscious memory.
5. You can't use the subconscious memory from any program residing higher than 768K in memory. (I don't know of any such programs; but if anyone writes such a program, it can't use the subconscious memory.) The problem is that the video memory is mapped to the 8088's address space above 768K. You'd disable your own program if its code were above 768K.

Most of the time, conflicts happen when more than one program is involved. You shouldn't have any problems if you restrict your use of the subconscious memory to a single program and prevent any other programs from running at the same time. In figuring out what works and what doesn't work, the best method will be trial and error (with lots of errors).

I'm hoping that this article will stimulate ideas among Z100 users about ways to use the subconscious video memory. I'd like to hear from you about your applications. You can reach me at the following address:

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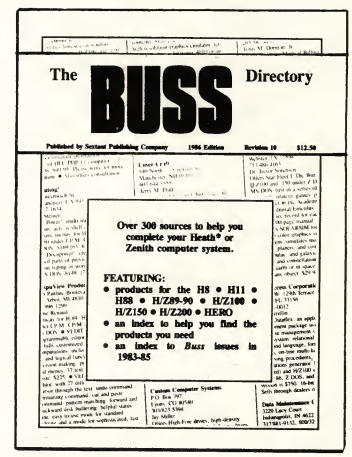
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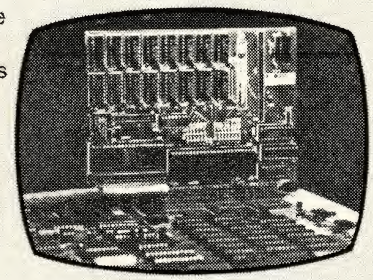

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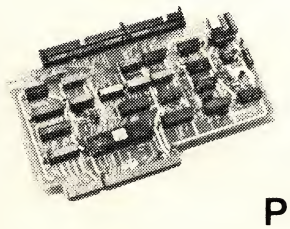

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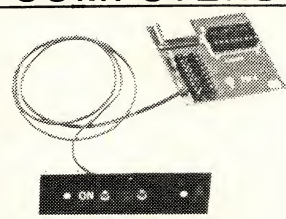

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The Eight-Bit World

Walter J. Janowski

Bogged down but still kicking

Making more spare time

Home Finance System

MEX

Winding down

Bogged down but still kicking

When I first started this column, I thought it would be an interesting way to utilize some of my spare time, although I was afraid I might soon run out of things to write about. As it turns out, I've got much too much to write about and too little spare time in which to do it.

Response from readers has been staggering. I have to apologize to those of you who may have waited over a month for responses to your inquiries, but the volume of incoming mail has been more than I can efficiently handle in my spare time. Vendors also have been filling my mailbox. (Thank you!) And, again, time constraints may delay any response. However, take heart—all incoming information will be duly acknowledged.

On the personal side, I'm also in the midst of a major kitchen remodelling in the renovation of my 100+-year-old farm house. Somehow the concept of spare time is something of a dim memory. Nonetheless, the show must go on.

Making more spare time

I have to admit to running on a relatively basic-configuration H89. I've added an extra disk drive, installed a serial interface and soft-sectored controller board, and brought the memory up to 64 kilobytes. Other than that, though, I'm rather basic. Up until recently I've been chugging along at a pokey 2-megahertz clock speed with the standard-issue Z80 microprocessor chip.

However, Darrell Pelan at Micronics Technology was good enough to send me one of his 2/4-MHz speed modifications for evaluation. I've got to admit I've become spoiled.

As a little background (repeated from my previous column), the H/Z89's stock central processing unit (CPU) chip is a standard Zilog Z80, which operates at a 2-MHz clock speed. Some time later, Zilog released an updated version of the chip—the Z80-A—which was capable of running at a 4-MHz clock speed.

Installing one of these in your '89 along with the other necessary modifications would effectively double the processing speed of your unit. Many users modified their '89s themselves. (A lot of them used the methods published in *REMark* by Pat Swayne. See "A Programmable 4 MHz Modification for the H89" in *REMark* #34, November 1982, and "4 MHz Update" in *REMark* #38, March 1983.) Also, many vendors developed modification kits.

The version from Micronics is called the Speed Mod. It's inexpensive ($34.95 assembled, $24.95 kit, $20 for the bare board) and quite simple to install. Installation requires that you replace the existing Z80 on your CPU board with the supplied Z80-A, replace chip U502 with the speed mod's circuit board, and connect a jumper wire. The whole process took me less than ten minutes.

Micronics also supplies the software necessary for 4-MHz operation. Under CP/M, a supplied program, called SPDBIOS, will automatically modify your Heath BIOS source code to provide 4-MHz operation at boot-up. You must then run MAKEBIOS to generate the new assembled BIOS. (See your CP/M documentation.)

Under the Heath Disk Operating System (HDOS), the necessary source code is supplied to modify the driver SY.DVD to support 4-MHz operation. Also, a special program to allow toggling between 2- and 4-MHz operation is provided for both CP/M and HDOS.

So, what do you gain from all this? First of all, don't expect your disk drives to operate any faster. They're already chugging along as fast as they can, so changing the clock speed has no visible effect on disk access time. (As a matter of fact, the Speed Mod "downshifts" to 2 MHz during disk access to maintain compatibility with existing disk-controller boards.)

Run any program that executes a lot of internal processing, however, and the difference becomes quite noticeable. For example, you have to sit through WordStar's here's-where-I-came-from-and-don't-you-dare-try-to-copy-me sign-on message only half as long as you normally would.

Almost any program written in BASIC runs faster, since its speed is dependent on the execution time of the interpreter. Directories, sorts, squeeze/unsqueeze functions all show a noticeable improvement in execution time.

OK, if this is all so great, what are the drawbacks?

First of all, your memory chips may not operate reliably at the faster clock rate. Run the internal memory test first thing to verify proper operation. (See your H89 operations manual.) If any memory chips fail, you may have to replace them—although this is a simple and inexpensive procedure. However, my '89 is a very early vintage, and none of my chips failed.

Second, not all programs may operate

properly at 4 MHz, especially those that provide "real-time" operation. This is not a major problem, however, since the SPEED.COM and SPEED.ABS programs allow you to switch back to 2-MHz operation when required.

In summary, I have been running at 4 MHz regularly for almost two months with no noticeable ill effects. And, as I said, I'm spoiled. I don't think I can ever go back to 2 MHz again.

While some hardware and software installation is required, the modification should be well within the technical capabilities of the average user. Anyway, you probably wouldn't be still hanging on to that old eight-bit monster if you weren't willing to poke around inside of it once in a while. At the price, this would be a worthwhile addition to any '89 system.

It's interesting how solving one problem can sometimes unexpectedly solve another. I mentioned in the previous column how installing the Speed Mod cleared up my problems with Write-Hand Man. It also resolved my major gripe with one of my favorite programs. . . .

Home Finance System

Way back in 1983 during the second National Heath Users' Group Conference in Chicago, I arrived determined to select a software package for managing my checkbook and expenses on my computer. The HUGCON gave me the opportunity to browse the offerings of several vendors, and my final selection was the Home Finance System from Jay Gold Software. I've never been sorry.

Home Finance System (HFS) is one of the most complete financial packages for home use that I've ever seen. Not only will it manage your checking accounts, but you can also use it to keep track of your assets (savings accounts, certificates of deposit, etc., even cash!) and your credit accounts and bill payments. It will maintain all the necessary records of deductible and non-deductible items for tax time. It even has provisions for generating your actual checks on your printer (using appropriate check forms).

The system is distributed on five 5¼" program disks along with a sample data disk. Also included is an easy-to-understand 130-page users' manual. The price for all this is only $89.

The original version I purchased was configured to run under HDOS. That version is no longer being offered, though. Now HFS is only available for CP/M. (The HDOS version of HFS was reviewed in Steve Howard's "Tracking Home Finances with the Home Finance System," *Sextant* #8, Winter 1984.)

HFS installation is simple. All that is required is copying the necessary program files onto a bootable startup disk along with a copy of Microsoft BASIC. An auto-install file will patch both MBASIC and the operating system to create a ready-to-run turnkey system.

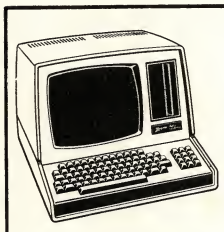
Along with its record-keeping features, my favorite function of HFS is balancing my checkbook against the bank statement. This used to be a tedious manual process; great time expenditures were often involved in tracking down errors when the balances wouldn't match.

A 4-MHz system with a RAM disk would make this a very impressive package indeed.

With HFS, you merely enter the info from your bank statement; the program does the rest. If for some reason your account won't balance, HFS provides a host of automated options to help you track down and correct the error (whether it's yours or the bank's).

In the manual's introduction, Dr. Gold states the philosophy behind the program: he wants it to take over as much as possible of the work you now do, while providing additional features you would not be able to accomplish otherwise. Suffice it to say that HFS gives you complete control to monitor every dollar that comes in or out of your household every month, and it lets you organize and generate reports from this information in almost any useful form you could require.

As with most software, HFS does have its weak points. Most notably, the program is written in MBASIC, and as such is sloooow! Also, program functions are written as separate modules and need to be loaded from the disks whenever they are required. Due to the size of the total package, on most systems the modules must be spread over several disks with the program prompting you for



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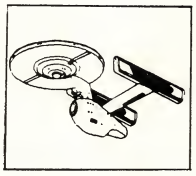

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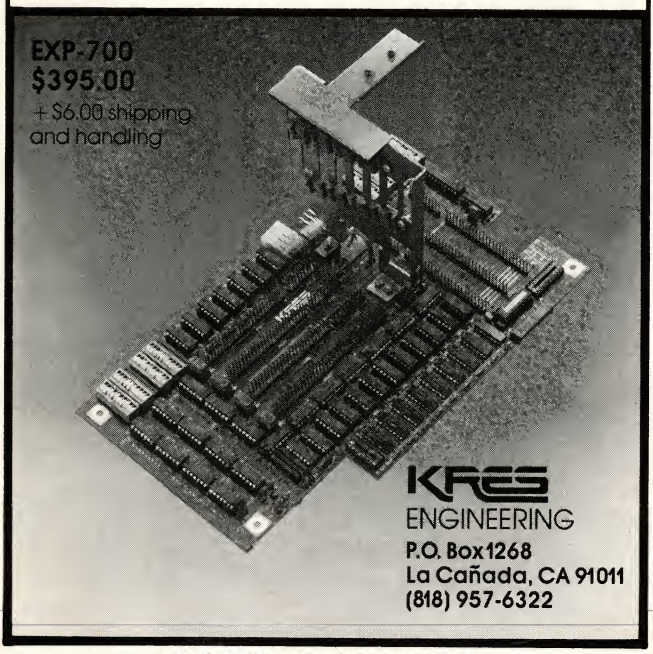


Circle #195 on Reader Service Card

the necessary disk swapping as required.

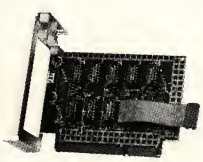
The easiest method of speeding up operation is (surprise!) boosting your system up to a 4-MHz clock rate. The speed mod shows itself more impressively on this software package than on any other program I own. At 2 MHz, HFS can be tediously slow, but at 4 MHz it becomes quite tolerable.

The program package is distributed in protected MBASIC form, and as such it can't be listed out on the screen or printer. Were the source code available, I would probably attempt to run it through a BASIC compiler to squeeze out a little more speed.

Finally, HFS should really fly on a system with a RAM disk. I realize I seem to be saying this about a lot of programs lately, and maybe one day soon I'll break down and buy one so I can endorse it first-hand. But anyway, an awful lot of time is lost during disk access with HFS. A 4-MHz system with a RAM disk would make this a very impressive package indeed.

Don't let my criticisms mislead you. Home Finance System is a well written, well documented program that will accurately perform just about any task you could require in maintaining your household finances. Over the several years I have been using it I have found it to be completely bug-free. In a price-versus-feature comparison, the few drawbacks can be easily overlooked. This is a very powerful package and I recommend it highly.

HEATH/ZENITH 88, 89, 90 PERIPHERALS



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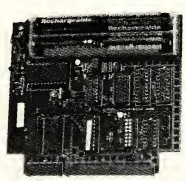

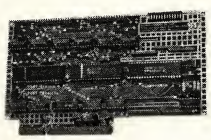

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MEX

Last time, I discussed the MODEM series of public domain telecommunications programs. This time I'd like to cover MEX, a highly sophisticated and flexible outgrowth of the MODEM series.

MEX was developed and copyrighted by Ronald G. Fowler of Fort Atkinson, Wisconsin. While Mr. Fowler holds the copyright to the program, he has released it for free exchange and for distribution of a non-commercial nature.

Developed as an extension of MODEM, MEX maintains a similar command structure and provides most of the features of MODEM (such as autodialing, dumb terminal emulation, XMODEM error-checking protocol, batch transfer, etc.). Users of MODEM should have little trouble adapting to MEX. However, MEX adds a host of sophisticated new features that put it in a class with such programs as Microstuf's Crosstalk or Hilgraeve's ACCESS.

MEX can be adapted to a large number of computers by use of an overlay file, in much the same manner as MODEM. As a matter of fact, MODEM overlays may be used to configure MEX with little or no modification. The overlay file may be patched manually onto the main file, using CP/M's DDT utility; or it can be done automatically with the public domain utility MLOAD.

So what makes MEX so special compared to MODEM? There are many new features and functions available. The CALL command followed by a number will automatically instruct an autodial modem to dial that number. The PHONE command will add numbers to the autodial library without any manual modification to the main program. The CLONE command will create a new version of MEX with all the currently set parameters as default settings.

But probably the most useful additions to MEX are the READ and SENDOUT commands. SENDOUT will send an ASCII string out to the modem as if it had been typed in at the keyboard. A series of SENDOUT strings may be stored on a disk as a file; the READ command can then be used to read the file and execute the SENDOUT commands.

Imagine, for example, the time (and expense) you could save by using a READ file to call CompuServe, log on, enter the HUG SIG, scan the messages and retrieve the ones addressed to you, store them on disk, and sign off automatically. You could then go back and browse through the messages from the disk at your leisure. You now have an automated telecommunications system. The possible applications are endless!

With the space and time I have available, I can only scratch the surface of the features available from MEX. A 40+-page users' manual is usually distributed with the program; both the program and the documentation file can be found on most bulletin-board systems. If you feel you're starting to outgrow the limitations of MODEM, take a look at MEX.

By the way, here's another feather in the cap for us eight-bit old timers. MEX is available for both CP/M and MS-DOS, but the MS-DOS version was not released for free distribution. Those with the three-digit H/Z computers must purchase MEX from NightOwl Software, Inc. of Fort Atkinson, Wisconsin, at a price of $59.95.

Winding down

With a little luck, by the time I get around to the next column my kitchen cabinets should be up, my stack of mail should be smaller, and I should be able to spend a little time lounging on the beaches of Lake Michigan in the Indiana Dunes.

Meantime, feel free to contact me with your questions, gripes, or ideas. You can reach me via GEnie, CompuServe, or good old U.S. mail. Electronic mail gets answered first; please include a self-addressed stamped envelope for U.S. mail.

As always, I will provide copies of any public domain software mentioned in this column. Just send me a blank diskette and $5 to cover postage and handling. I can support H17 and H37 formats, single- or double-sided, CP/M or HDOS. (Sorry, only 48-track drives.)

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Circle #103 on Reader Service Card

Print Big in BASIC (or Turbo Pascal)

The Z100 can read its own screen and enlarge the letters for greater visibility. It can even send them to a printer—sideways, if you prefer.

Peter Wentworth

By printing large banners above important listings you can easily identify the printouts. Using Z-BASIC on the Z100, there is an easy and elegant method of printing large lettering. The technique also allows you to print these large characters on the screen—and even sideways on the printer.

On most systems, such a program is fairly straightforward, but extremely tedious. Your approach would probably be to create an array to store the shape of each character; then you would use some sort of look-up each time you needed to find a character.

Setting up such an array is long-winded and time consuming. Moreover, it seems strange that you would need to tell the system about the shapes of its own characters; it already seems to know what shapes to use for normal text on the screen. So, maybe . . . .

Looking at the screen

The Z100's screen can be viewed in two ways—as a character-based 25-line by 80-column display, or as a pixel-based 225- by 640-pixel display. Pixel rows (called scan lines in the Heath/Zenith literature) are numbered starting at 0 and going up to 224; the pixel columns are numbered from 0 to 639.

It follows that each character is displayed on the screen within a block of 9 x 8 pixels. Each pixel in this block is either on or off, with the shape of the character formed by the pattern of pixels which are on.

Fortunately, ZBASIC's POINT function helps us determine which pixels are on for any character in a known location on the screen. The POINT function takes the coordinates of any of the 72 pixels of the character as arguments, and returns a number indicating the color of that pixel. Any number greater than zero means the pixel is on.

In fact, what we will do is simple: each time we find the pixel is on, we will print an asterisk; each time it's off, we will print a space. This immediately gives us a new large character, nine character-rows deep and eight character-columns wide, basically the same shape as the original character.

The program in Listing 1 demonstrates how to print large characters on the Z100's screen. The display has been limited to a width of 10 characters on the assumption that the printing device (in this case, the screen) is only 80 columns wide.

By changing the PRINT statements after line 50 to LPRINT statements, we can send the output to a printer. Some of you have wide printers or can print more than 10 characters per inch on your printers; you should have no trouble in adapting the program to handle more characters. Just increase the 79 in line 90 to one less than the number of expanded characters your printer can handle.

Going further

Once we've gone this far, there are many extensions which spring to mind.

An obvious improvement would be for the program to accept a string longer than 10 characters and automatically break it up into shorter lines at appropriate places. (An appropriate place is presumably at a space character.) Also, the possibility of printing two characters for each pixel allows for letters which are bolder.

The program in Listing 2 prints notices sideways on the printer. This version can accommodate six lines of printout, each 30 characters long. It can easily be extended to handle up to 80-character lines.

Graphics?

It is worth pointing out that these programs would also work with graphics shapes on the screen.

However, if you draw a circle on your screen and dump this to the printer, you will get an ellipse. The reason for this is simple—the Z100 screen has 640 pixels across and only 225 down. This means that the pixels are more closely packed in the horizontal direction. In addition, the screen is not square.

To plot good-looking circles and squares on the screen, an adjustment is needed (and can be done by Z-BASIC). The technical term which describes this adjustment is the "aspect ratio"; in my Z-BASIC manual, under the CIRCLE com-

```
10 REM   This program demonstrates how to print large characters
20 REM   on the screen.  Written by P. Wentworth, 2 October 1984.
30 INPUT "Please type your text, up to 10 characters.  "; A$
40 CLS
50 PRINT A$                ' Now we know the text is on the topmost line
60 PRINT : PRINT
70 FOR ROW = 0 TO 8        ' There are 9 pixel rows
80 Q$ = ""
90    FOR COL = 0 TO 79    ' and 80 pixel columns
100      IF POINT(COL,ROW) > 0
               THEN Q$ = Q$ + "*"
               ELSE Q$ = Q$ + " "
110   NEXT COL
120   PRINT  Q$
130 NEXT ROW
140 END
```

Listing 1. A Z-BASIC program to enlarge the screen display of any ten characters typed at the keyboard.

Peter Wentworth is a senior lecturer in the computer science department of the University of Port Elizabeth, South Africa. The University has a laboratory of 38 Z100s as part of its teaching resources. Peter also does research in functional languages, and is interested in contemporary folk music.

mand, it's given as 0.4375. What this means is that if you want a nice-looking square, you should plot 100 pixels along the X axis and only 100 x 0.4375 (about 44) pixels in the Y direction.

Having observed the problem, now let's compound it.

Most printers print 10 characters per inch across the page, but only 6 per inch down the page. (That is, their aspect ratio is 6:10). So, let's assume we start with a perfect square on the screen (100 x 44 pixels). If we print that square on the printer, we will end up with a rectangle 10 inches wide and 6⅔ inches deep. Not exactly square!

This problem is not unique to the programs given here. Most packages that offer graphics dump utilities have to compromise somehow, and this involves tuning the package's aspect ratio for particular printer hardware. You will also have to experiment with the aspect ratio you specify to Z-BASIC.

Turbo?

Finally, for those of you who are Turbo Pascal users, I include a Turbo Pascal listing of a program to print big letters. (See Listing 3.)

To do the job, I had to define my own POINT procedure—which contains a little messy address-mapping stuff. Translation of the other ideas in this article into Pascal should be straightforward. △

```
10 REM   This program demonstrates how to print large characters sideways
20 REM   on the printer.  6 lines of text are handled.
30 REM   Written by P. Wentworth, 2 October 1984.
40 CLS                              ' Now we know where the cursor is!
50 PRINT "Please type your text, up to 6 lines of 30 characters each"
60 FOR I = 1 TO 6
70  INPUT A$
80 NEXT I
90 '
100 REM  The user has typed the text into the top corner of the screen.
110 REM  We must now ignore the top row (it's our prompt) and the first
120 REM  character in every line (it's the ? from the INPUT).
130 REM  So we are interested in pixel rows 9 to 62, and columns 8 to 247
140 '
150 FOR COL = 8 TO 247              ' There are 8 x 30 = 240 pixel columns
160 Q$ = ""
170    FOR ROW = 62 TO 9 STEP -1    ' and 9 x 6 = 54 pixel rows
180      IF POINT(COL,ROW) > 0
               THEN Q$ = Q$ + "*"
               ELSE Q$ = Q$ + " "
190   NEXT ROW
200   LPRINT  Q$
210 NEXT COL
220 END
```

Listing 2. This Z-BASIC program can be used to print large characters sideways on the printer.

```
{ This program demonstrates how to print large letters in Pascal.
  Written by P. Wentworth,  2 October 1984.                          }

VAR   ROW,COL : INTEGER;
      A : STRING[72];

FUNCTION POINT (PIXELCOL, SCANLINE : INTEGER) : BOOLEAN ;

  { This function tests the appropriate pixel in the green plane, and
    returns TRUE if it is set, else returns false.
    The function numbers its pixels and expects its arguments
    in the same order as the Z-BASIC POINT function - i.e. the top left
    hand pixel is at position (0,0) and the bottom righmost point is at
    pixel number (639,225).   (Who ever heard of anyone numbering their
    graph paper with zero at the top? )                                 }

VAR     OLDPORT, BYTENUM, BITNUM, ROWNUM, BYTEADDRESS   : INTEGER;

  BEGIN
      OLDPORT := PORT [$D8];            { Get the contents of video port }
      PORT [$D8] := OLDPORT AND 127;          { Set VRAM access bit off }
      BYTENUM := PIXELCOL DIV 8;                { Which byte do we want }
      BITNUM  := (8 - (PIXELCOL MOD 8));    { Which bit within that byte }
      ROWNUM  := (SCANLINE DIV 9) * 16 + SCANLINE MOD 9;
      BYTEADDRESS := (ROWNUM SHL 7) OR BYTENUM ;
      { Get the byte and shift the required bit to the lowest position   }
      POINT  := ((MEM[$E000:BYTEADDRESS] SHR BITNUM) AND 1) = 1;
      PORT [$D8] := OLDPORT ;       { Restore original state of the port }
  END;

BEGIN
   CLRSCR;
   WRITELN('COMPUTER');
   FOR ROW := 0 TO 8 DO
    BEGIN
     A := '' ;
         FOR COL := 0 TO 79 DO
             IF POINT(COL,ROW) THEN A := A + '*' ELSE A := A + ' ' ;
     WRITELN(A);
    END;
END.
```

Listing 3. A Turbo Pascal program to display eight large letters on the screen.

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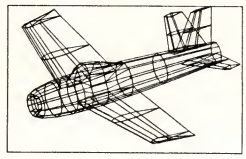

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Z100 Notebook

William N. Locke

What age beauty?

Basic batch

The Software Engineering Handbook

Perks revisited

REACH-86

SHIFT-F12 and resident programs

What age beauty?

I must confess to a moment of weakness. I recently heard that the government had contracted for a vast number of the new AT-compatible Z248s, and I thought I would go and check out the field. Perhaps I should switch to that machine as my primary development computer. I currently use a ZW-118-42—an 8-megahertz low-profile Z100 with a hard-disk drive and 768 kilobytes of random-access memory (RAM).

The Heath store was a bit far to drive for a first look, so I drove to a local computer store that sells the real "AT" produced by IBM. I had the store salesman do a fine job of attempting to sell me the machine. He said that it ran at 8 MHz, it had a hard disk, it had about 500K of memory, and it could put text on the screen.

The graphics adapter would be a few hundred dollars extra. To get up to a megabyte of RAM would cost me a few more hundred. They sold color monitors for a few more hundred. Without these extras, the thing would be about $6,000. The features that I had asked for would drive the cost of the machine up to about $7,500. The salesman did point out that the screen doesn't flicker the way the IBM Personal Computer does.

I left the computer store in dismay at what I'd seen. I'm sure that the ATs are loaded with neat features. And I do realize that one can purchase a Z200-series computer for less than these prices. But, with a NEC V20 microprocessor installed in an 8-MHz 768K computer that can be bought for less than $2,000 on the second-hand market, I'm willing to be content. The Z100 community will have me to kick around for a while longer.

One additional comment. I asked the salesman if the IBM Personal Computer AT was compatible with the new Zenith machine that the government was buying. He explained that I didn't understand. He said that IBM brought out the standards and other people copied them.

Standards my eye! How did the exciting computer business of a few years ago get so stuck in the mud? What we need is a 64-bit microprocessor addressing a few megabytes of RAM in a portable machine manufactured by Heath/Zenith. We could allow this new machine to run PC-DOS, I suppose.

Basic batch

Many people are hesitant to start using batch files. This is because the commands associated with batch files are not needed to start out with a computer, and the first-timer can skip them. And often the time is not available to go back and do some detailed studying of the manual for the Microsoft Disk Operating System (MS-DOS).

A batch file is an ordinary text file filled with normal MS-DOS commands; the operating system will execute these commands one after another. The file must have .BAT as its extension, and the main file name cannot be the same as an .EXE or .COM file on the system.

Example: Create a file named COPIER.BAT, containing the following:

```
DIR B:*.EXE/W
DIR B:*.COM/W
PAUSE PUT DISK IN A: AND PRESS RETURN
COPY B:*.EXE A:
COPY B:*.COM A:
```

Now, typing COPIER will provide a directory of all files with .EXE and .COM extensions, display a prompt, and copy all .EXE and .COM files from drive B: to drive A:.

The batch-file capability in MS-DOS version 2 and later is greatly enhanced over earlier versions; you are now able to do jumps, loops, and logical tests within a batch file. In order to use these features, a few basic ideas need to be understood.

Parameters: When you type a batch file name followed by some other file names or words, these names are passed into the batch file as parameters. In writing the batch file, you allow for these by using percent signs followed by numbers (%1, %2, %3, . . ., %9). In this way, the command line can hold as many as nine parameters passed to the batch file. Each parameter is separated in the command line by a space.

For example, let's take a batch file, CMP.BAT; it uses MS-DOS's file-compare utility, FC, and has the following form:

```
FC A:%1 B:%1
```

Typing CMP MYFILE.C would check to see if the file MYFILE.C on drive A: is the same as the file with the same name on drive B:.

SHIFT: The SHIFT command is used to shift the parameters one place to the left relative to the numbers used with the percent signs inside batch files.

Say the command line is:

```
BAT_PROG JOE MIKE JOHN JIM
```

Then, when BAT_PROG is run, the %1 parameter would contain the name JOE, the %2 parameter would contain MIKE, etc. After a SHIFT command, JOE would be dropped and the %1 parameter would contain MIKE. After yet another SHIFT, %1 would contain JOHN. After a fourth SHIFT,

the parameters would be exhausted. As indicated above, a batch file can recognize no more than nine parameters at once. However, so long as the command-line length does not exceed a total of 127 characters, as many command-line parameters as desired may be accessed by using SHIFT.

IF <CONDITION> <COMMAND>: This statement is used to test for a condition within a running batch program. <CONDITION> is the logical test condition used to decide whether or not to take the action specified by the <COMMAND>.

Three types of conditions may be tested.

1. The existence of a file on a drive may be tested as follows:

```
IF EXIST D:MYFILE.C <COMMAND>
```

or

```
IF NOT EXIST A:MYFILE.C <COMMAND>
```

2. A string may be compared with another string or with a null string (nonexistence) to test for equivalence:

```
IF "%1.C" == "OLDFILE.C" DEL %1.C
```

(Delete if parameter is OLDFILE.C.)

or

```
IF NOT "%1" == "" GOTO RESTART
```

(GOTO RESTART if %1 *is not* a null string.)

3. The error-level code returned to the operating system from some programs may be tested to find out if errors have occurred. (In C, for example, these codes are transmitted to the operating system using the exit(n) function, where "n" is the number transmitted.)

The following are examples of this testing:

```
IF ERRORLEVEL 1 GOTO DONE
IF NOT ERRORLEVEL 2 EXIT
```

A useful batch file example: The commands discussed above may be combined to form powerful batch files. The example in Listing 1 will compile a group of program modules with a compiler (XCOMPILE), and then place these modules into a library (MYLIB.LIB). If an error occurs, the batch program warns you, skips that module, and goes on to the next module.

Other statements that are helpful in designing batch files include: FOR, ECHO, and EXIT.

I have tried to get your interest up. Now get into your MS-DOS manual and see what else can be done. (You might also want to look at "Standard Operating Procedure" in *Sextant* #10, May-June 1984, for Peter Norton's "Take Advantage of Z-DOS Batch Files." And I commented on calling batch files from within batch files in "The Z100 Notebook" in *Sextant* #22, May-June 1986.)

The Software Engineering Handbook

I am a long-standing member of the *Byte* book club, which sells McGraw-Hill computer books. This book club has paid off well in bringing computer-theory books to my door over the past several years. You do have to be selective in which titles you accept, however, or else you will have to pawn your computer to support the book habit. The books run about forty dollars each.

My latest acquisition through the book club is a rather interesting text titled *The Software Engineering Handbook*, prepared by the General Electric Company. This is a formal specification of a method for developing software regardless of the size of your company. You could be setting policy for a software house employing many people; or you could be a one-man or one-woman coding machine. The ideas should work equally well in either case.

The processes of planning, specifying, designing, coding, testing, and maintaining software are set down clearly. These include detailed guidance on ways to measure the progress of software projects through each phase.

One of the more enlightening areas described in the handbook is the proper distribution of effort in developing software. The tasks are broken down as follows:

Overall planning should take up 5% of the total effort; developing the specifications for your software should take up 10%; design should be 25%, coding 20%, and testing 40%.

Often, we get an idea for a nifty software item and sit down and start coding. The handbook makes it clear that this hacking is dead wrong.

Coding is only a fifth of the job, and it should not start until about 40% of the total effort is expended. One section of the book points out that a common reason for failure of a software project is developing code ahead of the specification and design phases.

The handbook gives a comprehensive testing philosophy and explains developing cost estimates for software, figuring out data flow in programs, and designing well structured code.

This book is certainly dry, but I highly recommend it for people even remotely considering development of software for anything more than writing a name fifty times on the screen in BASIC. I don't think that all the recommended documentation is needed for every case, but the design philosophy sure beats endless bug fixing.

Perks revisited

The Perks desktop utility was reviewed, with similar utilities, by David Felstul in *Sextant* #20. (See "Software Roundup: Five Desktop Utilities for the Z100," January-February 1986.) Since that time, Barry Watzman has published a new version, and it has most certainly become a powerful piece of software.

The basic concepts of Perks remain the same. The program sits in memory until you want to use its features. Pressing SHIFT-BREAK (or any other key you configure Perks for) will make the Perks menu overlay your program on the screen, and you are free to use the Perks features. When you are through using Perks, your program will pick up where it was before Perks was activated.

When activated, Perks will give you a main menu containing the following choices:

Calculator—This is a standard four-function calculator, but it also includes several features for handling hexadecimal numbers and doing logical operations such as AND, OR, and XOR. The calculator provides a storage memory and allows results to be transported from memory back to your program.

ASCII table—This table contains the 128 ASCII codes for all the standard control characters and ordinary keyboard characters of the Z100. It also shows the special block-graphics characters available with the Z100. This module is a handy reference for your Z100.

Appointment Calendar—This module is both a daily appointment schedule and a calendar showing the month. A day is chosen by moving the cursor to the date

```
REM This batch file will compile and library many modules
REM Usage: BATCOMP module_1 module_2 module_3 module_4 ...
:restart
MYCOMPILE %1
IF ERRORLEVEL 1 GOTO error lib
MYLIB - %1 + %1;
DEL MYLIB.BAK
SHIFT
IF NOT "%1" == "" GOTO restart
GOTO done
:error
PAUSE A compile error was found in %1.c
SHIFT
IF NOT "%1" == "" GOTO restart
:done
LIB MYLIB , MYLIB.LST
REM Have a nice day.
```

Listing 1. BATCOM.BAT is an MS-DOS batch file which would compile a group of program modules under a compiler of your choice (MYCOMPILE), and store them into a library (MYLIB.LIB).

in the displayed calendar month and pressing "L". The appointments for the day pop up in a separate window. The calendar can display any month in the 20th century.

Filer and Setup—This module gives you a means to obtain a directory of any disk, set any of eight timers, set the screen saver, and perform various Perks configuration functions.

Notepad—The notepad uses WordStar's editing conventions, as is now common in several word processors and editors. This module has been changed to allow the user to specify the buffer size when Perks is activated. The range of allowed values is 2K to 64K.

Card File—This new module provides an electronic card file. Each card may contain five lines with up to 32 characters per line. This makes a nice address book. A total of 2,912 cards can be stored, and they can be sorted and printed.

Modem and Dialer—This new module allows automatic dial-up and basic modem control for quick and easy communications. A full range of communication speeds, echo options, and stop bits are supported. The modem module can be used in normal conversation mode, and it supports the XMODEM error-checking protocol for binary file transfer.

Typewriter—This new module provides a quick way to write notes on the printer. It lets the printer either print each character as you type it or print each line after the RETURN key is pressed. This feature is a handy way to do things such as addressing envelopes or typing quick notes.

Cut and Paste—These new modules allow you to pick up a section of the screen display from your application program and save it for placing somewhere else in another or the same application program. This is a particularly handy addition to the Perks system.

This revised version of Perks makes it an extremely strong utility. The memory usage is approximately 76K plus the notepad buffer size. A 4K buffer will require about 80K, and a 64K buffer will require about 140K. I strongly recommend this program to anybody owning a Z100 with a large memory.

I understand that there is a Z150 version of Perks under serious consideration—so serious that it may be a reality by the time you read this.

REACH86

It is not often that I find a program that is good enough to cause me to break old habits. This is true even when a new word processor is available with many new features. I like to stay with my good old editor rather than teach all those fingers all those new keys. Call me lazy. That's it—just lazy.

Well, I have a new modem program. It's not filled with bells—it's simple, and it's inexpensive. The program is called REACH86, and it's a product of The Software Toolworks. One distribution disk contains versions for both the Z100 and the IBM-compatible computers.

I think that the reason I like this program is that everything seems to be obvious. The Toolworks has mastered the use of bottom-line prompts. These prompts take you from modem-conversation mode to file-receive mode, and so on, without there ever being a need for concern about how you got where you are and how to get back. I was able to understand how all of the REACH86 features work without reading the manual and without having to wade through endless menus.

I might add that, after you've told REACH86 to send a received file to disk or do other housework, it takes over only a small section of the middle of the screen when it prompts you for further information. The text is still there on screen, with the window bordered by a particularly nice pattern.

Here are some specifics on the REACH86 capabilities:

- Modem transfer rates of up to 9600 baud are provided.
- File transfer is allowed between computers by direct cable.
- Binary or ASCII file transfer is possible using XMODEM, CompuServe A, or other error-checking file-transfer protocols.

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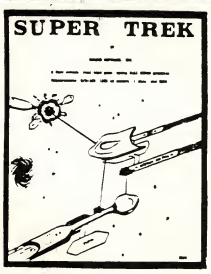

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• Group file transfers are supported using selections from the disk directory. The directory is displayed on a window from inside REACH86.
• File deletion from inside REACH86 is supported.
• Function keys can be programmed to emit sequences of up to 60 characters to a remote computer. This is particularly nice for automatically logging on to a remote computer. Also, you can program a function key so that it will recognize incoming data from the remote computer (a password request, say) and give an appropriate response.
• Program configuration is supported using a configuration file which is automatically called when REACH86 is executed. This configuration includes the function-key definitions.

SHIFT-F12 and resident programs

This month's example program for the Z100 takes on two questions. These are: What does the SHIFT-F12 key do that makes it special for use in programs such as the MS-DOS screen-dump programs? And how can I write a program so it will stay resident even while other programs are being run?

SHIFT-F12 (F12 pressed with the SHIFT key pressed) has a special effect on the Z100-series computers. It causes the computer to interrupt what it is doing and execute the code whose location is stored at the interrupt-five space in the interrupt jump table at the very beginning of the computer memory (segment 0000:0000).

Each address in the interrupt jump table has both an offset and a segment value; so, each interrupt requires four bytes. The interrupt-five location is thus 20 bytes up from the 0000:0000 location.

To build a program that will stay resident and be able to be called during the operation of other programs, one needs to do the following:

1. Write the program such that all register values are preserved on execution.
2. Ensure that the data segment used for the interrupt program is distinct from the data space used by the application program.
3. Ensure that the interrupt-service routine is terminated with an IRET rather than a RET. If the interrupt is to be passed along to other service routines, use a long jump as shown in the "Z100 Notebook" timer program in *Sextant* #22.
4. Don't try to execute interrupts from inside interrupts. Use BIOS entry points as shown in Listing 2.
5. Terminate the installation with an INT 27; the DX register should contain the offset of the last code that needs to be saved.

The example program in Listing 2 is a framework inside which you can build a resident program that will be activated by pressing SHIFT-F12. All that this example actually does is print a string on the

Listing 2. A resident program which prints a message on your screen when you press SHIFT-F12. You can use the framework to build your own resident program. A full version has been uploaded onto DL9 in the Heath Users' Group bulletin board on CompuServe.

```
COMMENT !
                        Z1ØØ Notebook
                        Resident Program Example
                        MS-DOS Help Screen

  This  demonstration  program  is based in part on the techniques
  used by John W. Spalding  in  the  creation  of  a  screen  dump
  program  for  the  Epson  MX-8Ø.   That  program was once on the
  COMPUSERV network in the HUG SIG DL6 named GPRINT.ASM

  Assemble as follows:
                    Name the program NB_HELP.ASM
                    Now do the following:
                    MASM NB_HELP.ASM;
                    LINK NB_HELP.ASM; ( Ignore the Stack message )
                    EXE2BIN NB_HELP NB_HELP.COM
 Execute as follows:
                     NB_HELP
                     Press SHIFT F12 any time in or out of a program

!
;************************************************************************
;  This is the BIOS entry point definition for character output.  Other
;  BIOS entry points are on page 8.21 of the Programmer's Utility Pack.
;  These  definitions  are  included  in the file, DEFBIOS.ASM, and the
;  functions are explained  in  the  file,  PBE.ASM.   Both  files  are
;  included on the Z1ØØ BIOS disks in the Utility Pack.

; HELP_TEST EQU 1  ; Activate this line for testing the help string

BIOS_SEG    SEGMENT AT 4ØH
            ORG     6
BIOS_CONIN      LABEL FAR       ; Console input
            ORG     9
BIOS_CONOUT LABEL FAR
BIOS_SEG    ENDS

;************************************************************************
; This is the interrupt-five vector at the base segment of memory

VECTOR_WIDTH =  4               ; Interrupt table entry width is
                                ; segment and offset, four bytes.
BASE_SEG SEGMENT AT ØH
        ORG     5*VECTOR_WIDTH  ; Twenty bytes from ØØØØ:ØØØØ
INT5_VECTOR  LABEL   DWORD      ; Label the position
BASE_SEG ENDS

;************************************************************************
; The program's action starts here and jumps directly to the installation
; code at SETUP below. The code between here and SETUP is the actual
; interrupt service routine.

CODE        SEGMENT
            ASSUME  CS:CODE, DS:CODE
            ORG     1ØØH

START:

IFDEF HELP_TEST ; This is for testing the help string only. Non resident
            CALL    INT_FUNCT    ; Print the string
            CALL    BIOS_CONIN   ; Wait for an input character
            MOV     AH, ØØH      ; Exit the program
            INT     21H
ENDIF       ; End of the testing code
            JMP     SETUP

; This is the actual service routine
INT5:       CLI                  ; Disable interrupts
            PUSH    DS           ; Save all registers
            PUSH    ES
            PUSH    SI
            PUSH    DI
            PUSH    BP
            PUSH    DX
            PUSH    CX
            PUSH    BX
            PUSH    AX
            PUSH    CS       ; Establish the data segment for the service
            POP     DS       ; Routine to be the same as the code segment
            CALL    INT_FUNCT ; This is the actual interrupt service routine
            POP     AX       ; Restore all register values
            POP     BX
            POP     CX
            POP     DX
            POP     BP
            POP     DI
            POP     SI
```

➔

```
            POP     ES
            POP     DS
            IRET            ; Return from the interrupt

; This example program simply outputs a string. You should build your
; own resident program here to meet your needs.

HELP_MESS   DB      13,10,'The Z100 Notebook MS-DOS HELP Demo,
            DB      'William N. Locke', 13,10
            DB      '[D:] [Pathname] ASGNPART [u:] [Partition [;System] d:]'
            DB      13,10
            DB      '[D:] [Pathname] ASSIGN[x = y[...]]'
            DB      13,10
            DB      '[D:] [Pathname] SUBST d: [/d] | [ [d:] pathname]'
            DB      13,10,'>',0

INT_FUNCT:
            MOV     SI,OFFSET HELP_MESS
            CALL    PUTSTR      ; Output the string to the terminal
            RET

;*************************************************************************
;                           PUTSTR
;
; This function will output a string whose head address is in SI.
; The string should terminate with a zero byte.

PUTSTR:     MOV     AL,BYTE PTR [SI]
            OR      AL,AL       ; Quit if the zero byte is found
            JNZ     PUTCHAR
            RET
PUTCHAR:
            CALL    BIOS_CONOUT ; Output the character in AL
            INC     SI          ; Go on to the next character in the string
            JMP     SHORT PUTSTR

RES_PGM_END:        ; This is the end of the resident program.

;*************************************************************************
;    Code after this point is lost after initial execution

; The first step in execution is to determine if the resident program is
; previously installed. This is done by checking to see if the offset
; of the interrupt service routine is already placed in the interrupt
; vector location, INT5_VECTOR.
SETUP:
            XOR     AX,AX                       ; Make AX zero
            MOV     ES,AX                       ; Place the zero in ES
            MOV     AX,ES:WORD PTR INT5_VECTOR  ; Contents of INT5_VECTOR to AX
            MOV     BX, OFFSET INT5             ; Offset of INT5 to BX
            CMP     AX,BX                       ; Compare the two
            JNZ     SETINT                      ; If not the same go on
            MOV     SI,OFFSET INSTALLED         ; Otherwise quit
            CALL    PUTSTR
            MOV     AH, 4CH                     ; Terminate without resident
            MOV     AL,1                        ; Exit code 1
            INT     21H                         ; section installation

; This code does the actual setup of the interrupt 5 to contain
; the address of the service routine, INT5. The code segment of
; this routine is placed at the location INT5_VECTOR + 2 and
; offset of the service routine is placed at the location
; INT5_VECTOR itself.
SETINT:
            XOR     AX,AX                   ; Make AX zero
            MOV     ES,AX                   ; Place the zero in ES
            CLI                             ; Disable interrupts
            MOV     ES:WORD PTR INT5_VECTOR,OFFSET INT5
            MOV     ES:WORD PTR INT5_VECTOR+2,CS
            STI                             ; Enable interrupts

;This code outputs the startup string, HELLO.
            MOV     SI,OFFSET HELLO
            CALL    PUTSTR

;This interrupt exits the program leaving the code above RES_PGM_END
;reserved for future use. See page 4.178 Programmer's Utility Pack
            MOV     DX,OFFSET RES_PGM_END
            MOV     CL,4
            SHR     DX,CL    ; Divide number of bytes by 16, ( 2^4 )
            INC     DX       ; This is the number of 16-byte paragraphs
            MOV     AH,31H   ; Terminate and keep process
            MOV     AL,0     ; Exit code zero
            INT     21H

; This data region is lost when program exits
HELLO       DB    13,10,'The Z100 Notebook resident Help demo is on.',13,10
            DB    13,10,'Press SHIFT F12 to activate.',13,10,0
INSTALLED   DB    13,10,'Help demo was previously INSTALLED',13,10,0
CODE    ENDS

        END     START
```

screen of your computer when SHIFT-F12 is pressed. The string (found in the HELP_MESS section of the program) is just a description of three MS-DOS commands. It should be noted that the computer does not see this string as input in any way when it is printed. The computer simply outputs the string to the terminal.

You can easily expand this help message by adding more commands and explanations. The point to note is that the last line of the HELP_MESS section should terminate in a zero to indicate the end of the total string.

To make things more convenient, I have uploaded a full version of Listing 2 onto DL9 in the Heath Users' Group bulletin board on CompuServe.

Additional Information

The Software Engineering Handbook, $59.50.
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A Fail-Safe Disk-Mount PROLOGUE for HDOS

If there's no disk in the drive, start without it.

Duane W. Small

One of the nice things about the Heath Disk Operating System (HDOS) is the PROLOGUE feature. If you have a program that you invariably run when you boot from a particular system disk, just put it on the disk and name it PROLOGUE.SYS. On boot-up, HDOS searches the system disk for a program with that name. Finding it, HDOS will execute it.

Unfortunately, a typical HDOS PROLOGUE program which mounts disks will wait indefinitely if one of the selected drives doesn't have a disk in it. TIMNT, the program presented in Listing 1, offers the user more flexibility: renamed as PROLOGUE.SYS, TIMNT "times out" the mount, bypassing drives with no disks.

In order to time how long a mount is taking, TIMNT must have access to the interrupt signal from the system clock. HDOS interrupt service is handled through the monitor routines in the H8's or H/Z89's read-only memory (ROM). The program illustrates a correct method of using the clock interrupt; we must ensure we do not disrupt other routines (specifically, the disk device driver) which also depend on this interrupt.

Since the program may abort a .MOUNT system call in progress, it also gives some consideration to the potential problems left behind by half-finished system calls.

As an added point of flexibility for the user, TIMNT transfers the "run PROLOGUE on boot" capability to non-system disks. It simply looks for a PROLOGUE file on any disks it has mounted. Finding one, TIMNT executes it.

Thus, putting a PROLOGUE program on a data disk can let you decide whether you want a particular application program to automatically run on boot-up. This lets a single system disk serve multiple applications, without losing the convenience of an application-specific PROLOGUE program.

As presented in Listing 1, TIMNT assumes a three-drive system. It is easily modified to accommodate systems with either more or fewer drives, including those with more than one disk device type.

The program consists of two parts. The main body of the program is given in sections 1-10 of Listing 1; it mounts disks and transfers control to a PROLOGUE program if one is present on one of the mounted disks. It also sets up the second part, the interrupt routine (section 11 of Listing 1).

The program . . . "times out" the mount, bypassing drives with no disks.

The main routine inserts the address of my interrupt routine where the monitor ROM normally looks for the address of the HDOS clock-interrupt routine. In this way, TIMNT's interrupt routine will be run with each system clock interrupt. TIMNT aborts any disk mount operation that has taken too long, and causes the system to continue execution of the main routine.

Setting up the interrupt

There are three elements involved in successfully using the clock interrupts under HDOS. The first task is to establish a jump to the code to be executed by the ROM-based interrupt-service routine. The second is to ensure that nothing interferes with execution of HDOS's clock-interrupt code. And the third is to restore the system before exit, so that the ROM interrupt routine does not continue to call TIMNT's interrupt routine after TIMNT no longer exists.

In the order of operation, we will first have to protect the clock-interrupt code, and make provision for an orderly exit. Then we can establish the jump to TIMNT's interrupt routine.

When a clock interrupt occurs, the ROM-based interrupt-service routine executes a JMP instruction found at HDOS's user interrupt vector table (.UIVEC). To avoid disrupting HDOS's clock-interrupt code, section 2 of the main routine saves the previous contents of .UIVEC+1.

They are stored as INTRET, which will be the address portion of the JMP instruction that ends the program's interrupt code; instead of returning to TIMNT, the interrupt will continue with the system-clock routine. Restoration will be performed in section 7 by simply retrieving the original contents of .UIVEC+1 and storing them there. The program can then exit safely.

Finally, since the ROM-based interrupt-service routine executes a JMP instruction found at .UIVEC, storing TIMNT's interrupt-code address at .UIVEC+1 suffices to cause the code to be executed.

Of course, I disable the system-clock interrupt whenever TIMNT is modifying what happens as a result of a clock interrupt. I have to do this since the results of having an interrupt occur when only part of the adjustments have been made could be quite unpleasant.

Mounting the disks

Sections 4 and 6 of the main routine constitute the conventional code of any HDOS disk-mounting PROLOGUE program. If disks are present on both SY1: and SY2:, both sections of code will be executed, and the intervening sections will not affect program behavior.

The .MOUNT system calls will fail if there is no disk in a drive. Failure will be reflected by never returning from the .MOUNT call, however, rather than by a return with an error code. Failures to return, therefore, will be handled by the routine-aborting process discussed later,

Duane W. Small has a Ph.D. in experimental psychology, and has done research on the human/computer interface. He has also worked as an "unadulterated" computer professional, and now works for the Mitre Corp., addressing questions of how effectively people can use computer systems.

and the program will continue.

Other errors, such as might occur as a result of read failure or a corrupt disk, are handled by a call to a short error-reporting subroutine. (See section 10 of Listing 1.) It is important to note that TIMNT will not abort itself on error—before exiting for any reason, TIMNT has to execute the code that restores the system-clock interrupt.

Executing PROLOGUE.SYS on data disks

Section 9 uses HDOS's .LINK system call in a straightforward attempt to execute any PROLOGUE.SYS program on a disk just mounted. The first such PROLOGUE found will be run, since a successful .LINK system call never returns.

HDOS's .LINK system call can fail because no disk was mounted or because no PROLOGUE.SYS file exists on a disk. Neither is an error from the point of view of this program, so the program doesn't check for errors. It just tries for a PROLOGUE on SY2: if the .LINK to SY1: fails, and it executes a normal exit if the second .LINK also fails.

Aborting unsuccessful .MOUNT system calls

The whole point of having TIMNT establish clock-interrupt code is to abort failed .MOUNT system calls. The interrupt-service routine in section 11 of Listing 1 is basically very simple: it counts down a two-byte value in INTCNT. Until the value is zero, this routine skips everything else, doing nothing more than jumping to the system-clock-interrupt routine's address stored at INTRET.

When the count reaches zero, the interrupt routine aborts whatever was going on. Instead of returning to the interrupted code when processing is complete, it "returns" to a location whose address is saved in RETLOC. But it must do so in a devious manner.

We need to avoid disrupting the normal execution and return from the system-clock interrupt. Therefore, it is necessary to jump as usual to the system clock routine when TIMNT's interrupt code has finished its work. I want the system clock routine to jump to the location in RETLOC instead of to the indefinitely waiting system .MOUNT routine.

To do this will require a little knowledge of the way the ROM routines process an interrupt.

Before a user's clock-interrupt routine is entered, the computer ROM saves onto the system stack the contents of all of the registers, including the pre-interrupt stack-pointer value. But before the ROM saves any of those values, the interrupt itself causes a return address—the program counter at the time of interrupt—to be pushed onto the stack.

After the ROM is done, the return address is in the two bytes beginning 12

```
CLKCNT  EQU     175Ø
        XTEXT   MTR             ;ROM MONITOR DEFINITIONS
        XTEXT   ASCII           ;                                       1
        XTEXT   HOSDEF
        XTEXT   HOSEQU
        ORG     USERFWA
*-------------------------------------------------------------------------
START   EQU     *
        LHLD    .UIVEC+1        ;CLOCK INTERRUPT VECTOR
        SHLD    INTRET
        DI                      ;                                       2
        LXI     H,TIMEOUT       ;MY INTERRUPT ROUTINE
        SHLD    .UIVEC+1
*-------------------------------------------------------------------------
        LXI     H,S2MNT         ;WHERE TO GO IF NO SY1:
        SHLD    RETLOC
        LXI     H,CLKCNT        ;                                       3
        SHLD    INTCNT
        EI
*-------------------------------------------------------------------------
        LXI     H,DISK1         ;MOUNT SY1:
        SCALL   .MOUNT
        CC      ERROR           ;                                       4
        MVI     A,NL            ;BLANK LINE ON CONSOLE
        SCALL   .SCOUT
*-------------------------------------------------------------------------
S2MNT   DI
        LXI     H,LINK          ;WHERE TO GO IF NO SY2:
        SHLD    RETLOC
        LXI     H,CLKCNT        ;                                       5
        SHLD    INTCNT
        EI
*-------------------------------------------------------------------------
        LXI     H,DISK2         ;MOUNT SY2:
        SCALL   .MOUNT
        CC      ERROR           ;                                       6
        MVI     A,NL            ;ANOTHER BLANK LINE
        SCALL   .SCOUT
*-------------------------------------------------------------------------
LINK    DI                      ;GET RID OF TIMEOUT
        LHLD    INTRET          ;ORIGINAL CLOCK VECTOR                  7
        SHLD    .UIVEC+1
*-------------------------------------------------------------------------
        LXI     H,USERFWA       ;RESTORE STACKPOINTER TO ELIMINATE
        SPHL                    ;            GARBAGE                    8
        EI
*-------------------------------------------------------------------------
        LXI     H,PROLOG1       ;LINK TO PROLOGUE PROGRAM ON DISK 1
        SCALL   .LINK
        LXI     H,PROLOG2       ;IF NONE, TRY DISK 2
        SCALL   .LINK           ;                                       9
        MVI     A,Ø
        SCALL   .EXIT           ;EXIT IF NO PROLOGUE AVAILABLE
*-------------------------------------------------------------------------
ERROR   DI
        LXI     H,Ø
        SHLD    INTCNT
        EI                      ;                                       1Ø
        MVI     H,NL
        SCALL   .ERROR
        RET

DISK1   DB      'SY1:',Ø
DISK2   DB      'SY2:',Ø
PROLOG1 DB      'SY1:PROLOGUE.SYS',Ø
PROLOG2 DB      'SY2:PROLOGUE.SYS',Ø
*-------------------------------------------------------------------------
TIMEOUT EQU     *
        LXI     H,CLKCNT
INTCNT  EQU     *-2             ;                                       11
        DCX     H
        SHLD    INTCNT
        MOV     A,H
        ORA     L
        JNZ     MORE
        LXI     H,14Q           ;LOCATION OF USER RETURN IN STACK
        DAD     SP
        LXI     B,Ø             ;RETURN ADDRESS TO ABORT MOUNT PROCESSING
RETLOC  EQU     *-2
        MOV     M,C             ;SAVE IT IN PLACE OF USUAL RETURN
        INX     H
        MOV     M,B
MORE    JMP     Ø
INTRET  EQU     *-2

        END     START
```

Listing 1. Source code for TIMNT.

bytes (14 octal) above the stack pointer. Therefore, my interrupt code inserts the value in RETLOC at that point, in place of the original return location.

Now TIMNT's interrupt routine can jump to HDOS's system-clock-interrupt routine as usual. When that routine exits, it will "return" to the saved RETLOC address; so, whatever was going on when the interrupt occurred is permanently aborted.

For TIMNT's interrupt routine to work correctly, it must be given both an initial count, to tell it how long to wait, and an address to return to after it has timed out. Sections 3 and 5 of the main routine take care of this matter (section 3 for SY1:, section 5 for SY2:).

Sections 3 and 5 each store the value of CLKCNT in the counter location. They also store in RETLOC the location of the mount attempt for the next disk; or if the last disk is about to be tried, they store in RETLOC the address of the interrupt restoration and .LINK/.EXIT code.

CLKCNT is defined in section 1 as 1750; with the two-millisecond tic counter provided by standard Heath hardware, this gives a wait time of three-and-a-half seconds. Different systems may require different values, so some experimentation is in order. For systems with more than one disk type, it may be desirable to use different values for the different drives.

As a general rule, mounts take less time if you always give the system a BYE command before powering down, because the drives' read-write heads will then be left over Track 0. Short disk labels also reduce mount time, since displaying the label is part of the mount process.

The general principles involved in modifying the program to handle a different number of disk drives should now be clear. For each disk drive, the main routine provides a new wait time and a new program address to be given control if the wait time expires; then the main routine turns the interrupt on and executes the appropriate .MOUNT call. The interrupt routine as written takes care of the rest.

The error-reporting subroutine in section 10 also stores a value in the interrupt code's counter location. The point here is to prevent the .ERROR system call from being aborted, so zero is stored. It takes over a minute to count all the way around to zero again, so the program-aborting process is effectively disabled.

Cleaning up after an abort

Aborting any system call is a bit messy. The code in section 8 of the main routine does sufficient cleanup in the case of aborting a MOUNT.

The system .MOUNT code pushes various values onto the stack; if the program were to exit with those values still there, HDOS would complain that they make no sense.

Clearing the stack by restoring the stack pointer to USERFWA takes care of the problem.

The procedure in section 8 may not be adequate in all cases. Tests of a version for a Z47 8" disk system produced intermittent ?FATAL SYSTEM ERROR? messages when a data disk was not present.

I found that the program works if a master reset (MVI A,2; OUT 170Q) is issued to the disk system whenever the .MOUNT call times out. So, apparently, the aborted .MOUNT leaves the disk subsystem in a state that complains about subsequent attempts to read other disks.

A final warning

In your own programming, you might wish to divert an HDOS system call from its customary operation. Just remember that any program that tries to abort such processes may run into particular problems depending on what is being done.

The problems described above should serve as a warning. Running your program, the system may act strangely. So, until it is clear that the program works, it is a good idea to use only disks that are backed up. That way, losing data will not be disastrous. (Of course, other programming errors and hardware failures can destroy disks, so backups are a good idea in any case.) △

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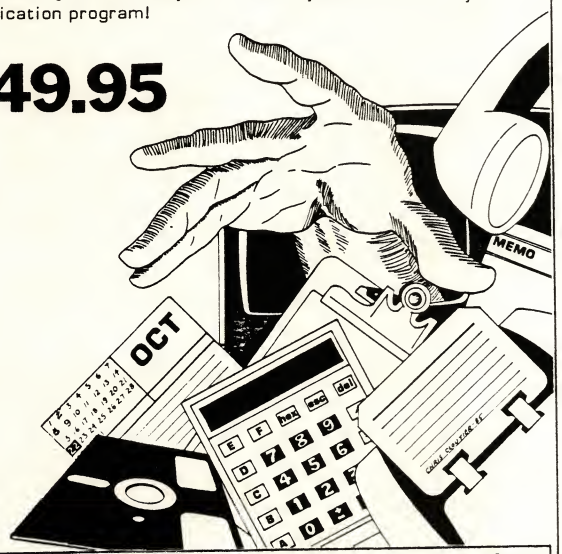

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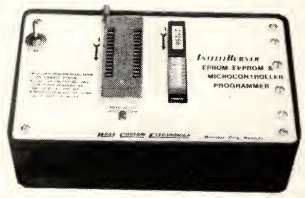

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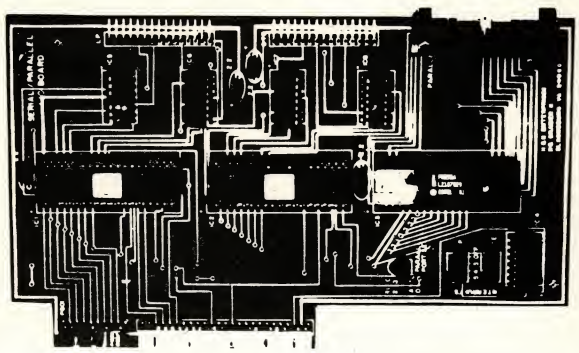

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C Notes

Joseph Katz

Computer Innovations' C86

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Computer Innovations' C86

Heath chose well in deciding to offer Computer Innovations' Optimizing C86 as its C compiler. At $395, C86 is a top-ranked, professional-quality compiler for the Microsoft Disk Operating System (MS-DOS). I have Version 2.30F, which I assume is the current version.

Although the catalogue implies C86 is only for the H/Z150, it works perfectly on the H/Z100, too. I use it on both. No, it doesn't require any adapter board, program, or tinkering to use on the Z100: it works just fine without the Gemini or EasyPC boards, Pat Swayne's ZPC, or any other emulator. In fact, since I have 768 kilobytes of random-access memory (RAM) in my 8-megahertz Z100, I prefer compiling big programs on a huge RAM disk there, even if they are destined for use on an IBM-compatible computer.

My speculation is that the Heath catalogue department focussed on the presence of C86's first-rate libraries specific to the IBM Personal Computer, noted the absence of anything similar for the Z100, and concluded that the package was for one kind of machine, to the exclusion of the other. Or maybe it was a marketing decision to write off the H/Z100. I hope not.

At any rate, C86 is excellent for the H/Z150s because of the compiler's IBM-PC libraries. They include a pretty good range of IBM-compatible video, communications, and printer functions. To clear the screen and home the cursor, for example, a program need only call the function `crt_cls( )`, which is defined in the IBM-PC libraries. There is no need to write such common functions on your own or buy a commercial library to get them. They're included. And all those I've had occasion to use work perfectly on my Z150 and H158.

Of course, C86 has no H/Z100-specific libraries: I say "of course" because, so far as I know, *no* compiler package on the market does. Nor are there any commercial libraries, again so far as I know, to fill the vacuum. To clear the screen on an H/Z100, therefore, you'll either have to write your own functions or get them from sources such as this column, and build them into your own library. No other C compiler does the H/Z100 user any better.

The C86 package comprises four disks and a manual. On the disks are the compiler, libraries, source code for the libraries, headers, and some compiler utilities.

The compiler makes four passes, each in a separate program: CC1, the preprocessor; CC2, the parser; CC3, the code generator; and CC4, the optimizer. When routine compilation ends successfully, the product is a Microsoft object file (PROGRAM.OBJ), one step away from the executable program. The object file must be linked with a library to expand functions such as `main( )`. If the program uses any other externals—such as `crt_cls( )`—they will require linkage to other libraries.

C86 supports both the 8086 small-memory model (64K of code and 64K of data) and the big-memory model (one megabyte of combined code and data, allocatable according to 8086 restrictions). It also supports 8087 and software math operations. And it supports functions common to MS-DOS Version 1 and Version 2, as well as functions in MS-DOS 2 only (such as for handling hierarchical directories). There are libraries to support combinations of these functions, so there are eight standard libraries on the distribution disks. Add the two IBM-specific libraries—IBMPCS for the small model and IBMPCB for the big model—and there are a total of ten libraries supplied with the C86 package. That is a lot of libraries. (Beta test versions of libraries for a medium-memory model are available, as of this writing, on the C86 User's Group Bulletin Board.)

C86 also includes source code for the libraries. Some C packages do not, making it an optional purchase. My *unshakable* position is that library source code is a necessity, not a frill, because it's hard to use a tool well without knowing how it works.

The utilities included with C86 are Marion the librarian (it's not *my* joke), Arch the archive manager, and USQ the unsqueezer. Think of Marion as a substitute for LIB, Microsoft's object librarian, which creates and maintains a library to be used in the linking stage. Arch is nice because it produces straight ASCII files identified by headers it supplies: it uses the headers to recognize the modules should they need manipulation such as extraction or replacement. It's an efficient way to archive text files of any kind—not only source code—and one can squeeze (with the public domain SQ) to reduce disk storage space. Since most files on the C86 distribution disks are squeezed, USQ is provided to unsqueeze them when installing the package.

Installation may be too grandiose a term for this relatively simple process.

One identifies the needed files, copies them from the distribution disks, unsqueezes, and deletes the squeezed copies. Most novice and intermediate programmers will want CC1.EQE through CC4.EQE, STDIO.HQ, and C86S2S.LQB (the small-model, software math, standard library). Users of the H/Z150-series machines will also want IBMPCS.LQB. That group of files is everything from the distribution disks needed to begin programming.

There is an installation program, C86INST.EXE, which will "install" on a hard disk everything from the distribution disks. I don't think that's worth doing because files can be moved easily enough when they are actually wanted. (Here's a tip to make manual "installation" easier and neater on a hard disk: copy USQ.EXE to the subdirectory where you want the compiler, then unsqueeze files using that subdirectory as the default. USQ A:CC?.*, for example, will put the unsqueezed compiler files on the hard disk directly. If you have a floppy-only system, expect some hard work getting the needed files unsqueezed. C86 files essential to working with only the small-memory model take up nearly an entire floppy once they are unsqueezed.)

```
/*
** LOX.C -- control setting of CAPS LOCK and NUM LOCK keys
**
** Copyright (C), 1986, by JOSEPH KATZ
**
** 1.ØØ, Ø1/21/86, Joseph Katz
**
** LOX checks the two LOCK keys and manipulates them
** as directed by a switch supplied as arg[2]:
**              S or L  ...  LOCK
**                   U  ...  UNLOCK
**
** Requires Essential Software's C Utility Library
** compiled with CI C86
** link lox,,,escis c86s2s
**
*/

#include <stdio.h>

main(argc,argv)
int argc;
char *argv[];
{
puts("LOX");
puts("Copr. (C) 1986 by JOSEPH KATZ");
puts("Version 1.ØØ for \"C Notes\" in SEXTANT");

if( argc != 2)   error();              /* no switch specified */

/* check first character in first element of argv[1] */
/* to see if LOCK or UNLOCK (or SET or UNSET) wanted */

/* if SET or LOCK wanted */
if( (argv[1][Ø] == 's') || (argv[1][Ø] == 'S') ||
        (argv[1][Ø] == 'l') || (argv[1][Ø] == 'L') ) {
       if(!ifcaps()) tocaps();         /* if off, set on */
   if(!ifnumlok()) tonumlok();
   exit(Ø);
       }

/* if UNSET or UNLOCK wanted */
if( (argv[1][Ø] == 'u') || (argv[1][Ø] == 'U') ) {
       if(ifcaps()) ofcaps();          /* if on, set off */
       if(ifnumlok()) ofnumlok();
       exit(Ø);
       }

/* if bad switch  */
else   error();
}              /* end main() */

/*
** explain how to do things correctly
*/
error()
{
puts("FUNCTION:  Controls state of Caps Lock and Num Lock keys");
puts("SYNTAX:    LOX L[ock]  = on");
puts("           LOX S[et]   = on");
puts("           LOX U[nset] = off");
exit(1);
}              /* end error() */

/* end of lox.c */
```

Listing 1. Based on Essential Software's C utility library functions, LOX.C will set the "lock" keys according to the command-line specification.

Once the compiler is ready for use, you need add only a linker and an editor that likes you. Everyone has LINK.EXE, which comes on the Zenith Disk Operating System (Z-DOS) and MS-DOS distribution disks, and it does nicely. WordStar (in the "non-document" mode) will do as an editor, although there are editors with many more features useful in C programming—such as those providing automatic indenting that conforms to C's conventions. If you want to write your own assembly-language functions, you'll want an assembler: MASM.EXE, thrown in with Z-DOS, is an early version of Microsoft's macro assembler.

I don't know what to say about the C86 manual except that it *is* a C compiler manual, with the usual mixture of pluses and minuses. The strongest features of this manual are: pretty good examples of how to use most library functions; pretty good advice and warnings, sometimes; pretty good technical notes on several potentially sticky points; an index that often leads me to what I need; and a *superb* table of contents. Like most C compiler manuals, this one seems to have originated in documentation for someone who already knows C and just needs information about the compiler specifics. Then it seems to have followed Topsy's lead and "just growed." Someone new to C will need a good tutorial, like Kochan's *Programming in C*, to begin work with C86 or any other top-grade C package.

The bottom line is this: C86 is a grand choice if you want a compiler that will accommodate C programming on all levels, including development of commercial software. If you are a *complete* novice and that path intrigues you, consider using Computer Innovations' "Introducing C" package to start learning. (It was discussed in "C Notes" in *Sextant* #21, March-April 1986.) If you buy C86 and have a modem, you ought to send them $20 more to join the C86 User's Group for its excellent bulletin board system. (I understand there's also a newsletter, *Breakpoint*, from the group. I haven't seen it.) Computer Innovations is Big League—if you buy C86 directly from them, you can expect first-rate support.

Essential Software's C utilities

The ads for Essential Software's C Utility Library say it has "over 300 complete, tested, and documented functions." I don't dispute the tally and I won't bother checking it: there are 5⅔ pages of functions in the manual's table of contents listed on one line each.

They are divided into functions for the screen, graphics, printer and communications, memory management and program execution, keyboard handling, string processing, time and date processing, disk and directory processing—as well as miscellaneous functions to do simple things like get the MS-DOS version number, and complex things like move a block from one memory location to another.

The title is accurate: it's a C *utility* library—one of those commercial C libraries to consider seriously when you can't have more than one.

A good reason for buying a commercial library, of course, is to save the time you would spend writing comparable functions. At list price for 300+ functions, each function in the C Utility Library costs about sixty cents: dirt cheap. A few minutes—literally a few minutes—after unpacking the library, I used it to write a program that solved two nagging problems that had bothered me for some time.

My first problem was this: when my brain freezes and I want nothing more than to go outside and play with the rest of the kids, but know I won't return to work if I do, I fool around playing a computer game until I get whipped badly enough for writing to become the diversion. The current pastime is Qubert (a.k.a. "JBird"). Unfortunately, the darned thing shifts the state of the Num Lck key on the Z150. So, when I get back to writing, the numeric keypad sends out numbers when I want cursor movements.

My second problem is almost the opposite of the first and is created by a commercial time-and-billing program. It doesn't understand lowercase responses to "yes/no" prompts and, partly for that reason, it's easier to use with the Caps Lock key on. Entry of numbers is easier from the numeric keypad, naturally, so the Num Lck key ought to be on, too.

If you suggest that the thing to do is play Qubert before using the time-and-billing program, I'll ask you to leave the room.

A better solution to both problems is Lox (Listing 1). It makes sure the two "lock" keys are "locked" or "unlocked," as specified in a command-line switch when Lox is executed. Now I run Qubert from a batch file that calls Lox U on exit to make sure the "lock" keys are unlocked when I'm finished playing. Another batch file calls the time-and-billing program with Lox L (to lock the "lock" keys on entry) and exits with a call to Lox U (to set the keys back to normal). It's a handy little utility whipped together from functions in the C Utility Library. (I've uploaded LOX.EXE to CompuServe's HUG SIG—Go PCS 48—for fellow Qubert players and any other HUG member who wants it.)

I've done other things with this library, and I like it. I like it especially because it includes source code, so I can learn from it. My only real complaint so far is the manual. I don't know why, but I have trouble finding things in it. It's not that the manual is badly organized: functions are arranged alphabetically, with variants described on the same page as the "parent." Nor is there a want of locational aids: the table of contents is good, and there's a separate list of functions arranged by major groups ("screen handling and color printing functions," and so on). Maybe it's that one has to know the function name before it can be found. I don't know why, but it does take me time to find what I need.

Ordering Information

Optimizing C86 (MS-DOS), $395.
Directly from:
Computer Innovations
980 Shrewsbury Avenue
Tinton Falls, NJ 07724
800/922-0169 or 201/542-5920
Or as Part #CI-5063-1 from:
Heath Company
Benton Harbor, MI 49022
800/253-0570 (order line)

Programming in C by Stephen G. Kochan, ISBN 0-8104-6261-3, $18.95.
Hayden Book Company
Rochelle Park, NJ 07604

C Utility Library (MS-DOS), $185.
Essential Software, Inc.
P.O. Box 1003
Maplewood, NJ 07040
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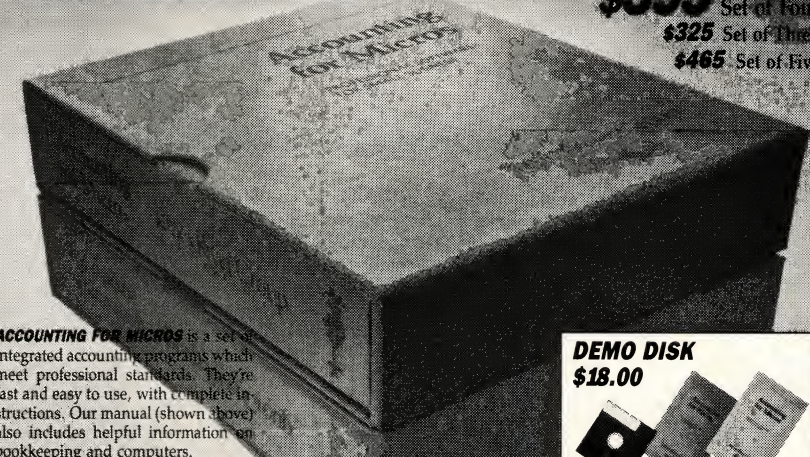

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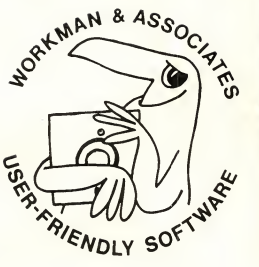

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Sorting on Your Terms Rather Than the Computer's

A Tiny Pascal program deals with the idiosyncrasies of bibliographic sorting.

Thomas F. Best

Aside from an occasional game of Gravitron, I use my H89 mainly for word processing. Since I'm a teacher and historian, this includes bibliographies ranging in length from a few titles to many pages.

Like many programs, my SMARTSRT was born of frustration with available software—in this case, the lack of sort routines that could handle my material in the way I wanted.

What I needed was the ability to sort entries of any length, and to handle them in exactly the form which I normally use. I needed to be able to put a title at the top of the file, and to handle the special alphabetizing rules that cause editors to have fits. (Does "McAdo" come before "MacNeeley"?)

What I did *not* need were arbitrary limitations on the length of entries. Neither did I need arbitrary print-out formats, nor artificial delimiters which had to be inserted into the text. I wanted to sort on my terms, not the computer's.

After struggling with several available sorts and data bases, I explained my problems with field lengths and delimiters to my son. With the intuitive insight of a seasoned hacker, he said: "Why don't you read the entire file into one string, give each entry an address in the string, and, instead of moving entries around within the string, just access them in the order you want?"

I replied, "But BASIC limits string length to 255 characters." This earned the withering look you would expect from an 11-year-old who was halfway through the Heath Assembly Language Course.

So I began experimenting with Tiny Pascal, which allows an effectively unlimited string length. (Would you believe as much as 32 kilobytes for a single string?) That's what makes SMARTSRT possible.

SMARTSRT is written for the H/Z89 running under the Heath Disk Operating System (HDOS). Memory requirements and known limitations are discussed at the end of this article.

The dialect of Tiny that I work with is offered by Jim Teixeira, one of the leading gurus of the Heath/Zenith community. His company is SoftShop of Ashland, Massachusetts, and he offers his Tiny Pascal along with DISAS, his disassembler. For $25, you can get them both.

An entry may be of any length, even several lines and more than 255 characters.

The language is also available in an enhanced form from the national Heath/Zenith Users' Group. (You already know that if you followed William Tavolga's series of articles on Tiny Pascal. See "Introduction to Pascal," *Sextant* #11, July-August 1984, through #13, November-December 1984.) I should make it clear that I haven't worked with SMARTSRT in the HUG version, and don't know how much conversion would be required.

SoftShop also offers a CP/M version of Tiny Pascal (and DISAS) for $25. I don't have it and cannot advise on converting the program given here. Tavolga's series, however, was good at pointing out differences between the HDOS and CP/M versions.

What it does

SMARTSRT has the following features:

1. SMARTSRT imposes no artificial limitations on the material. An entry may be of any length, even several lines and more than 255 characters.

   The entry delimiter is two successive RETURNS—i.e., skipping a line between entries—which happens to be the standard form in my bibliographies. The end of an author's name is identified by a period and two spaces (". "), also standard.
2. A title mode allows you to place a title at the head of your file. It will be ignored during the sort, but put back when you view the file on the screen or write it to disk. The title uses the only artificial delimiter in SMARTSRT, and it is automatically stripped off if you send the file to your printer.

   You delimit the title by putting an "*" as the first character in the file, and another "*" immediately after the last letter in the title.
3. Anonymous works (without an author's name) are alphabetized by the first significant word of the title (ignoring the articles "A", "An", and "The").
4. Multiple works by the same author are alphabetized by title; again, by first significant word, ignoring "A", etc.
5. If there is more than one work by the same single author, it is often customary to print the author's name with only the first work. For subsequent entries, the author's name is replaced by eight underline characters ("_____"). SMARTSRT supports this "multiple works" convention, but it can be disabled if you want.
6. If an author is also editor or co-author of other works, the single-author titles are listed first, followed by the edited and then the co-authored works. In case of co-authored works, the author's name is repeated each time.
7. "Mc-" and "Mac-" are both alphabetized as if spelled "Mac." They are ordered within the M's rather than placed in a separate group before the M's.
8. Once the file is sorted, it can be previewed on the screen, written to disk, or

Dr. Thomas Best taught biblical studies and comparative religion for ten years in the United States. He now works for the Faith and Order Commission of the World Council of Churches in Geneva, Switzerland.

```
1.  Unsorted Order--as you might enter the material

    Mabbott, Timothy, and Best, Will.  Dream Ascents:
      The Matterhorn in Fair Weather and Foul.  Peterborough,
      New Hampshire:  Monadnock Press, 1983.

    A Survey of Great Climbing Feats, 1850-1900.  Boston:
      White Mountain Press, 1972.

    Mabbott, Timothy, ed.  Strength Tables for Climbing Ropes.
      Peterborough, New Hampshire:  Monadnock Press, 1983.

    McAndrew, Ann.  Safety in Climbing.  Boston:  White Mountain
      Press, 1972.

    MacAndrew, Joan.  How to Get Started in Rock Climbing.  Boston:
      White Mountain Press, 1975.

    Mabbott, Timothy.  How I Fell from the Eiger;  or, What Am I
      Doing Here in the First Place?  London:  Hippo Press, 1964.

    Jones, Robert W.  "A Walking Tour Through the Cevennes," Journal
      of Mountaineering 21 (1978), 1-21.

    _______.  Technique and Equipment for Alpine Climbing.
      Berkeley:  Mountain Press, 1978.

    _______.  Ascents in Switzerland and the Rockies.
      Denver:  Mountaineering Press, 1980.


2.  Sorted Order--as SMARTSRT outputs the material with
    "Multiple Works" feature enabled

    Jones, Robert W.  Ascents in Switzerland and the Rockies.
      Denver:  Mountaineering Press, 1980.

    _______.  Technique and Equipment for Alpine Climbing.
      Berkeley:  Mountain Press, 1978.

    _______.  "A Walking Tour Through the Cevennes," Journal
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    Mabbott, Timothy.  How I Fell from the Eiger;  or, What Am I
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      Peterborough, New Hampshire:  Monadnock Press, 1983.

    Mabbott, Timothy, and Best, Will.  Dream Ascents:
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      Press, 1972.

    MacAndrew, Joan.  How to Get Started in Rock Climbing.  Boston:
      White Mountain Press, 1975.

    A Survey of Great Climbing Feats, 1850-1900.  Boston:
      White Mountain Press, 1972.


3.  Sorted order--as SMARTSRT outputs the material with
    "Multiple Works" feature disabled

    Jones, Robert W.  Ascents in Switzerland and the Rockies.
      Denver:  Mountaineering Press, 1980.

    Jones, Robert W.  Technique and Equipment for Alpine Climbing.
      Berkeley:  Mountain Press, 1978.

    Jones, Robert W.  "A Walking Tour Through the Cevennes," Journal
      of Mountaineering 21 (1978), 1-21.

    Mabbott, Timothy.  How I Fell from the Eiger;  or, What Am I
      Doing Here in the First Place?  London:  Hippo Press, 1964.

    Mabbott, Timothy, ed.  Strength Tables for Climbing Ropes.
      Peterborough, New Hampshire:  Monadnock Press, 1983.

    Mabbott, Timothy, and Best, Will.  Dream Ascents:
      The Matterhorn in Fair Weather and Foul.  Peterborough,
      New Hampshire:  Monadnock Press, 1983.

    McAndrew, Ann.  Safety in Climbing.  Boston:  White Mountain
      Press, 1972.

    MacAndrew, Joan.  How to Get Started in Rock Climbing.  Boston:
      White Mountain Press, 1975.

    A Survey of Great Climbing Feats, 1850-1900.  Boston:
      White Mountain Press, 1972.
```

Figure 1. A comparison of Sections 1, 2, and 3 above illustrates how SMARTSRT handles some special sorting problems.

sent to the printer.

(Incidentally, the alphabetizing principles follow *A Manual of Style* published by the University of Chicago Press, which is the most widely used style guide in my field. These rules are summarized in *A Manual for Writers* by Kate L. Turabian, also published by the University of Chicago Press; several editions have been printed.)

These features are illustrated in Figure 1.

In Figure 1, compare Section 1 (the unsorted file) with Section 2, which is the same file as sorted by SMARTSRT. Note the handling of the works by "Mabbot" (single-author, edited, and co-authored) and the "Mc-" and "Mac-" titles.

In Section 2, the one "anonymous" work has been alphabetized under the first significant word of its title ("Survey"). For the second and third works by "Jones, Robert W.", the eight underline characters have been supplied instead of the author's name. Note that in the third work the quotation mark and initial article have been ignored. Note also the order of the single-author, edited, and co-authored works under "Mabbot."

Finally, Section 3 shows the output with the "Multiple Works" feature disabled: the author's name (Jones, Robert W.) appears before all three of his titles.

Though SMARTSRT is optimized for bibliographies, it can also be used in many other sorting applications.

Remember that everything you type (whatever its format and length) will be part of the same entry, until you enter two successive RETURNs (i.e., skip a line). Thus, SMARTSRT is especially useful for *blocks* of text such as file cards.

Figure 2 illustrates research notes entered at random from several books. SMARTSRT will put the notes in alphabetical order by author for convenient filing. After sorting, you could use a text formatter to put each entry onto a separate 3″ x 5″ or 4″ x 6″ file card. (Such cards are now available with pin-feed edges for computer printers.)

SMARTSRT can also serve as a rudimentary data base, as illustrated by Figure 3.

Suppose you were entering recipes for different dishes from various cookbooks. You would enter the type of food first, then the name of the recipe and the source, then the recipe itself. (Remember to skip a line only between the different recipes.)

In effect, you are making "Chicken" and "Potatoes" into "field" headings. SMARTSRT will collect all the "Chicken" recipes together, then arrange them alphabetically by name. (They cannot be sorted by source, however. You can alphabetize only from the start of the record. This is not a data base, but basically a program to alphabetize bibliographies by author.)

This time, you could format the material to print out recipe cards.

Finally, you can use SMARTSRT as a conventional line sort by simply inserting blank lines between each line to be sorted. Then remove them after sorting is finished. (This will be easy to do if your text editor has a macro function where command strings can be read from a disk file or programmed into the special-function keys. It will probably be tedious otherwise.)

Operation

SMARTSRT is simple to use.

You will be prompted for an input file name, which must conform to HDOS file-naming conventions. Your file will be echoed to the screen as it is read in. (At this point in the process, the author's name will be given each time for multiple works.) You may use CTRL-S to freeze the scrolling and CTRL-Q to restart it.

You will be told the number of entries and characters in the file, and whether a title was detected. When you are ready, hit RETURN and the file will be sorted.

When the sort is complete, you will be presented with a menu giving you the following choices:

V = View the file on the monitor. Again, you can control the display through CTRL-S and CTRL-Q.

P = Print the file on LP:.

W = Write the file to disk. You will be prompted for an output file name. This must be different from the input name.

CTRL-C = Select new file. This allows you to process a new file without having to exit and reload SMARTSRT.

CTRL-A = Quit and return to HDOS.

After you choose to view, print, or write the file, you will be asked, "Repeat author's name in multiple works (Y/N)?" Repeating the name is necessary for file cards since each one needs the name at the top. Also, you may prefer to do bibliographies this way.

An "N" answer will write eight underline characters instead of the name for second and later works by the same author. (This is explained in #5 under "What it does," above.)

After each command is performed, you will be returned to the menu. This continues until you enter CTRL-A. (This is a "graceful" exit routine provided by Tiny Pascal, and is the only way to exit the program).

How it works

I referred to the basic principles of SMARTSRT above. I was pretty brief, so now let's take a closer look at how it works.

SMARTSRT does not rely on the common technique of assigning each entry to a separate string, and then moving the strings around until they are ordered. Instead, it reads the entire file into a single large string (CHR). As this is done, the starting address of each entry is

```
1.  Unsorted Order--as you might enter the material

    Zimmer, Peter Almlof.  People and Pestilence, p. 2.
         Effect of plagues on London population.

    Hall, Peter.  Boroughs of London, p. 82.
         Statistics on mortality rates due to plagues.

    Mouton, John.  Crime and Population, p. 306.
         Argues that overcrowding leads to increased crime
         rate.  Evidence cited from London, 1600-1650
         and 1800-1850.

    Hall, Peter.  Boroughs of London, p. 61.
         Discusses possible causes of rapid population
         growth in London (e.g. decline of traditional
         village life & growing unemployment there)


2.  Sorted Order--with "Multiple Works" feature disabled, ready
    for formatting and printout on file cards

    Hall, Peter.  Boroughs of London, p. 61.
         Discusses possible causes of rapid population
         growth in London (e.g. decline of traditional
         village life & growing unemployment there)

    Hall, Peter.  Boroughs of London, p. 82.
         Statistics on mortality rates due to plagues.

    Mouton, John.  Crime and Population, p. 306.
         Argues that overcrowding leads to increased crime
         rate.  Evidence cited from London, 1600-1650
         and 1800-1850.

    Zimmer, Peter Almlof.  People and Pestilence, p. 2.
         Effect of plagues on London population.
```

Figure 2. SMARTSRT can be used to maintain a file card system. Entries can be sorted after they have been typed in, and can even be printed on separate file cards.

```
1.  Unsorted Order--as you might enter the material

    Chicken
            Chicken a la King                        Joy of Cooking
               Dice left-over chicken
               Make white sauce (see recipe)
               Heat in 350 deg. oven until warm
               Serve on toast together with green salad

    Potatoes
            Duke of Earl Potatoes au Gratin          50s Cooking for the 80s
               Peel and slice potatoes
               Spread grated cheese over the top
               Bake in 300 deg. oven until done

    Chicken
            Roast Chicken                            Fannie Farmer
               Cut fryer into pieces as desired
               Coat pieces with mixture of corn flakes
               (crushed), honey, and milk
               Bake at 350 deg. for 1 hour


2.  Sorted Order--"Multiple Works" feature disabled, ready for
    formatting and printout on cards

    Chicken
            Chicken a la King                        Joy of Cooking
               Dice left-over chicken
               Make white sauce (see recipe)
               Heat in 350 deg. oven until warm
               Serve on toast together with green salad

    Chicken
            Roast Chicken                            Fannie Farmer
               Cut fryer into pieces as desired
               Coat pieces with mixture of corn flakes
               (crushed), honey, and milk
               Bake at 350 deg. for 1 hour

    Potatoes
            Duke of Earl Potatoes au Gratin          50s Cooking for the 80s
               Peel and slice potatoes
               Spread grated cheese over the top
               Bake in 300 deg. oven until done
```

Figure 3. By using "Chicken" and "Potatoes" as field headings, you can create an elementary data base of recipes, organized by food categories and alphabetized by recipe name.

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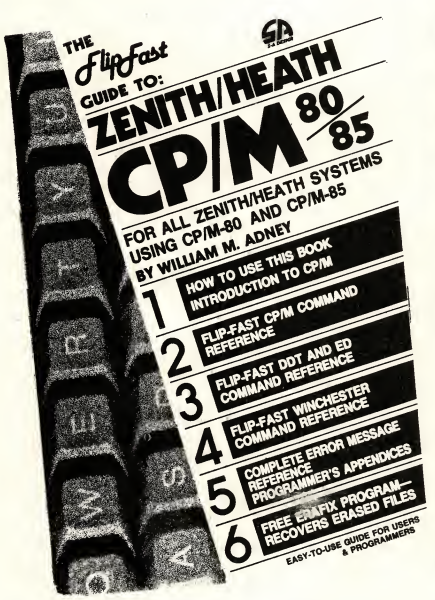
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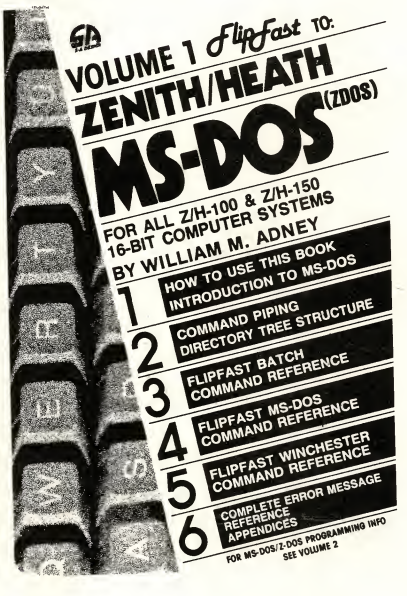
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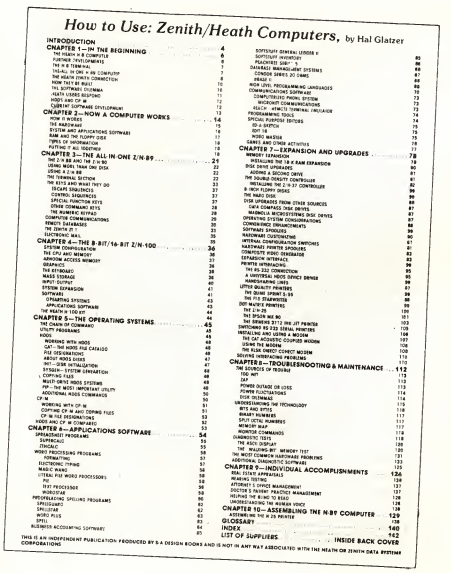

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recorded in an array, ENTRYADD[X].

If the lengths of the first three entries were 40, 160, and 300 characters respectively, we would have

ENTRYADD[1] = 1
ENTRYADD[2] = 41
ENTRYADD[3] = 201
ENTRYADD[4] = 501

This array is then used as a "look-up table" to access the entries themselves.

To print entry number 3, for example, the program would start at CHR[ENTRYADD[3]]—i.e., CHR[201], or character number 201 in the string CHR. Then it would print each character until it reached the end of the entry, which is marked by two successive RETURNs.

In order to sort, SMARTSRT compares the first character of each entry (i.e., CHR[ENTRYADD[1]] with CHR[ENTRYADD[2]]); if these are the same, it compares the second characters of each entry, and so on until different characters are found. Then if entry #2 needs to come first, it simply exchanges the values of ENTRYADD[1] and ENTRYADD[2], so that now ENTRYADD[1] = 41 and ENTRYADD[2] = 1.

Suppose that the correct alphabetical order of our four entries was #4, #2, #3, #1. SMARTSRT would adjust the values of our "address array" as follows:

ENTRYADD[1] = 501
ENTRYADD[2] = 41
ENTRYADD[3] = 201
ENTRYADD[4] = 1

If we then read out the entry beginning at ENTRYADD[1], followed by that beginning at ENTRYADD[2], ENTRYADD[3], and so on, the file will be output in alphabetical order.

SMARTSRT uses an insertion sort algorithm, modified for the special alphabetizing cases mentioned above.

For an excellent Pascal-oriented discussion of various sorting routines, consult *Algorithms + Data Structures = Programs* (Prentice-Hall, 1976), pages 56-124. This is by Nicklaus Wirth, the creator of Pascal. The basic insertion sort algorithm is given on page 61 of this book.

The whole subject of sorts is complex and surprisingly emotional, as proponents of shellsort, heapsort, quicksort, etc., argue which one is "best." Actually it depends on the situation.

Usually, the criterion for choosing a sort is speed; as the timing tables in Wirth's book make clear, the speed depends upon the number of items to be sorted and the degree to which the items are already in sorted order. Of course, there are other criteria, such as flexibility or ease of coding, which may be more important than speed in some applications.

While some techniques are more sophisticated and "glamorous" than the insertion sort, it is reasonably fast. Moreover, its relative simplicity is a distinct advantage in a program of this type, where numerous special cases have to be

Listing 1. The source code for SMARTSRT, written in Tiny Pascal for the H8 or H/Z89 under HDOS.

```
!                    SMARTSORT PROGRAM BY THOMAS F. BEST                    !
!                         VER. 6.4 / FEBRUARY, 1986                         !
!            WRITTEN IN JIM TEIXEIRA'S TINY PASCAL FOR H-89 (HDOS)          !
!                       COPYRIGHT 1986 BY THOMAS F. BEST                    !

!----------------------DEFINE GLOBAL CONSTANTS & VARIABLES-----------------!

CONST BELL = 7; NL = 10; EOF = 26; ESC = 27; AP = 39;

VAR M, X, Y, ENTRYNUMB, CHRNUMB, TITLEFLAG, TITLEEND, COMMAND,
    MULTIPLE : INTEGER;
CHR : ARRAY[11000] OF INTEGER; ENTRYADD : ARRAY[200] OF INTEGER;
    TITLE : ARRAY[200] OF INTEGER;

!--------------------------------WRITE HEADER-------------------------------!

PROC HEADER;

   BEGIN
      WRITE(ESC,'E',ESC,'Y',37,54,'************SMARTSORT************');
      WRITE(ESC,'Y',39,54,'Copyright 1986 by Thomas F. Best');
   END;

!-----------------------------GET FILE FROM DISK----------------------------!

PROC GETFILE;

   VAR I, J, K, L, FLAG, INPUT, CONT : INTEGER;

   BEGIN
     I := 1; ENTRYNUMB := 1; ENTRYADD[1] := 1; J := ENTRYADD[ENTRYNUMB];
     K := 1; L := 1; FLAG := 0; TITLEFLAG := 0; TITLEEND := 0;

     WRITE(NL,NL,NL,NL,'Input file name');          !GET NAME OF INPUT FILE!
     RESET('?');
     WRITE(ESC,'E');
     GET(INPUT);                                              !READ CHARACTER!
     WRITE(INPUT);                                            !ECHO TO SCREEN!

     IF INPUT = '*' THEN                                      !CHECK FOR TITLE!
        BEGIN
           TITLE[K] := INPUT;                                 !READ TITLE INTO!
           REPEAT                                              !SEPARATE ARRAY!
              K := K + 1;
              GET(INPUT);
              WRITE(INPUT);
              IF INPUT = '*' THEN TITLEFLAG := 1;
              TITLE[K] := INPUT;
           UNTIL (TITLEFLAG = 1) AND (INPUT <> '*') AND (INPUT <> NL);
           TITLEEND := K - 2; CHR[I] := INPUT; I := I + 1;
        END
     ELSE
        BEGIN
           CHR[I] := INPUT; I := I + 1;          !IF NO TITLE, ON TO MAIN LOOP!
        END;

     REPEAT                                                  !MAIN READ-IN LOOP!
           L := ENTRYADD[ENTRYNUMB];                        !SET START OF ENTRY!
           GET(INPUT);
              IF INPUT = '_' THEN IF L = I THEN       !CHECK AT START OF ENTRY!
                 BEGIN                                        !FOR '_' CHARACTER!
                    FLAG := 0;
                    REPEAT
                       CHR[I] := CHR[J];           !IF PRESENT, SUPPLY AUTHORS!
                       WRITE(CHR[J]);               !NAME FROM PREVIOUS ENTRY!
                       I := I + 1; J := J + 1;
                       IF (CHR[J] = '.') AND (CHR[J+1] = ' ')
                         AND (CHR[J+2] = ' ') THEN FLAG := 1;
                       IF (CHR[J] = ',') AND (CHR[J+1] = ' ')
                         AND (CHR[J+2] = 'e') THEN FLAG := 1;
                    UNTIL FLAG = 1;
                    REPEAT
                       GET(INPUT);
                    UNTIL INPUT <> '_';
                    IF (CHR[J] = '.') AND (INPUT = ',') AND
                      (CHR[J-2] = ' ') THEN
                         BEGIN
                            CHR[I] := CHR[J]; WRITE (CHR[J]); I := I + 1;
                         END;
                    IF (CHR[J] = ',') AND (INPUT = '.') AND
                      (CHR[J-1] = '.') THEN GET (INPUT);
                 END;
           CHR[I] := INPUT;
           WRITE(INPUT);
              IF INPUT = NL THEN IF CHR[I-1] = NL THEN     !FIND END OF ENTRY!
                 BEGIN
                    J := ENTRYADD[ENTRYNUMB];
                                                                        →
```

```
                ENTRYNUMB := ENTRYNUMB + 1;     !INCREMENT ENTRIES COUNTER!
                ENTRYADD[ENTRYNUMB] := I + 1;        !ASSIGN ENTRY ADDRESS!
              END;
        I := I + 1;
    UNTIL INPUT = EOF;                                !END OF FILE REACHED!

    ENTRYNUMB := ENTRYNUMB - 1; CHRNUMB := I - 2;

    WRITE(NL,'------------------------');
    IF TITLEFLAG = 1 THEN                            !CONSUMER INFORMATION!
      WRITE(NL,'Title detected with ',TITLEEND#,' characters.');
    WRITE(NL,'The text has ',ENTRYNUMB#,' entries and ');
    WRITE(CHRNUMB#,' characters.',NL,NL,'Hit <RETURN> to continue ');
    CONCL;
    READ(CONT);
  END;

!----------------------SET OFFSET (WHERE TO START SORTING)-------------------!

PROC OFFSET;          !CHECK FOR INITIAL ARTICLE AND SET Y := OFFSET IF NEEDED!

  BEGIN
    IF CHR[X] = '"' THEN Y := 1 ELSE Y:= 0;        !ADJUST FOR QUOTE MARK!
    IF CHR[X] = '"' THEN X := X + 1;                  !IF JOURNAL ARTICLE!
    IF (CHR[X] = 'A') AND (CHR[X+1] = ' ') THEN Y := Y + 2;             !A?!
    IF (CHR[X] = 'A') AND (CHR[X+1] = 'n') AND                         !An?!
      (CHR[X+2] = ' ') THEN Y := Y + 3;
    IF (CHR[X] = 'T') AND (CHR[X+1] = 'h') AND                        !The?!
      (CHR[X+2] = 'e') AND  (CHR[X+3] = ' ') THEN Y := Y + 4;
  END;

!-----------------------------------SORT FILE-------------------------------!

PROC SORT;

  VAR I, J, K, L, TEMP, FLAG, OSETA, OSETB  : INTEGER;

  BEGIN
    WRITE(ESC,'E','Now sorting...');                    !INSERTION SORT!
    FOR I := 2 TO ENTRYNUMB DO
      BEGIN
        J := I - 1; TEMP := ENTRYADD[I];

        REPEAT
          X := 0; FLAG := 0; OSETA := 0; OSETB := 0;

          IF (CHR[TEMP] = 'A') OR (CHR[TEMP] = 'T') OR    !CHECK INITIAL!
          (CHR[TEMP] = '"') OR (CHR[ENTRYADD[J]] = 'A') OR      !ARTICLE!
          (CHR[ENTRYADD[J]] = 'T') OR (CHR[ENTRYADD[J]] = '"') THEN
            BEGIN
              X := TEMP;    !PASS ADDRESS OF 1ST ENTRY TO OFFSET ROUTINE!
              OFFSET;          !GET OFFSET (IF ARTICLE) FOR FIRST ENTRY!
              OSETA := Y;                      !TRANSFER TO SORT ROUTINE!
              X := ENTRYADD[J];                    !DITTO FOR 2ND ENTRY!
              OFFSET;
              OSETB := Y;
            END;

          IF CHR[TEMP + OSETA] < CHR[ENTRYADD[J] + OSETB] THEN    !SORT!
            FLAG := 1;                                            !DONE!

          IF CHR[TEMP + OSETA] = CHR[ENTRYADD[J] + OSETB] THEN  !LETTERS!
            BEGIN                                              !EQUAL, SO..!
              K := TEMP + OSETA; L := ENTRYADD[J] + OSETB;

              WHILE CHR[K] = CHR[L] DO               !SCAN ENTRIES UNTIL!
                BEGIN                               !UNEQUAL LETTERS FOUND!
                  IF (CHR[K] = 'A') OR (CHR[K] = 'T')
                  OR (CHR[K] = '"') THEN
                    BEGIN
                      X := K;
                      OFFSET;              !CHECK 1ST ENTRY FOR ARTICLE!
                      IF (Y <> 0) THEN Y := Y - 1;     !ALLOW FOR FINAL!
                      K := K + Y;                    !INCREMENT OF LOOP!
                      X := L;                        !DITTO FOR 2ND ENTRY!
                      OFFSET;
                      IF (Y <> 0) THEN Y := Y - 1;
                      L := L + Y;
                    END;
                  K := K + 1; L := L + 1;          !MOVE TO NEXT LETTER!
                END;

              IF (CHR[K] = 'A') OR (CHR[K] = 'T') OR     !UNEQUAL LETTERS!
              (CHR[K] = '"') OR (CHR[L] = 'A') OR       !FOUND--CHECK FOR!
              (CHR[L] = 'T') OR (CHR[L] = '"') THEN     !INITIAL ARTICLES!
                  BEGIN
                    X := K;
                    OFFSET;
                    K := K + Y;
```

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written into the basic algorithm. (Incidentally, it is also quite fast on relatively short lists, and partly sorted lists.)

Programming always involves tradeoffs; the bottom line for me is that the extra work to code a faster algorithm is not worth the time I would save using it.

The program

SMARTSRT's source code in Teixeira Tiny Pascal is given in Listing 1.

The main thing to notice about Tiny Pascal in the context of this application is that it supports only integer variables. This is not the limitation it seems: values of a variable will be output as ASCII characters—unless you add a "#" switch (for decimal) or "%" switch (for octal). And an array may be filled with ASCII characters. Thus, CHR[5] would output an ASCII character, the 5th element in the array CHR.

Note that whenever a decimal output is required in SMARTSRT, the appropriate switch is used (e.g., ENTRYNUMB#). Also, comments are enclosed between "!" characters.

The following notes on specific procedures, together with the comments in the program itself, should help you to understand how SMARTSRT works.

GETFILE—The input routine first checks for the presence of a title, as signalled by the "*" characters. If these are detected, the title is stored in a separate string (TITLE) so it does not interfere with the sorting process. The input routine then proceeds through the rest of the file.

In case of multiple works by the same author, we have seen that the immediately following works may be input as follows:

Jones, Robert W. Ascents of the Matterhorn in the 18th Century. Berkeley: Mountain Press, 1982.

_____. Alpine Climbing Techniques. Berkeley: Mountain Press, 1982.

It would be disastrous if the second entry were read in literally; ASCII conventions place the character "_" before the numerical and alphabetical characters. The second and third works by different authors would all be alphabetized together before the A's!

To avoid that, whenever GETFILE detects such underline characters at the start of an entry, it supplies the author's name, which it has "remembered" from the previous entry.

After reading in the file, it indicates whether or not a title was detected, and gives the number of entries and characters in the file. (I think it's nice to have your software tell you what's going on.)

SORT—Most comparisons between entries are obvious ("A" comes before "B"). But, of course, life isn't always this simple.

If two entries begin with the same letter, the program scans the two strings

```
                    X := L;
                    OFFSET;
                    L := L + Y;

                    WHILE (CHR[K] = CHR[L]) DO       !ARTICLES OFFSET--!
                       BEGIN                        !ARE LETTERS UNEQUAL?!
                         K := K + 1; L := L + 1;
                       END;
                 END;

              IF CHR[K-1] = 'M' THEN      !ALLOW FOR Mc = Mac IN SORTING!
                 BEGIN
                    IF (CHR[K] = 'c') OR (CHR[K] = 'C') OR
                      (CHR[K] = AP) THEN IF CHR[L] = 'a' THEN L := L + 1;
                    IF (CHR[L] = 'c') OR (CHR[L] = 'C') OR
                      (CHR[L] = AP) THEN IF CHR[K] = 'a' THEN K := K + 1;
                    WHILE CHR[K] = CHR[L] DO
                      BEGIN
                        K := K + 1; L := L + 1;
                      END;
                 END;

              IF (CHR[K] < CHR[L]) THEN FLAG := 1;       !SORT, IGNORING!
              IF (CHR[K] >= 97) AND (CHR[L] < 97) THEN      !UPPER/LOWER!
                 IF (CHR[K] - 32) < CHR[L] THEN FLAG := 1;      !CASE IF!
              IF (CHR[L] >= 97) AND (CHR[K] < 97) THEN          !NEEDED!
                 IF CHR[K] < (CHR[L] - 32) THEN FLAG := 1;

              IF (CHR[L-1] = '.') AND (CHR[L] = ' ') AND  !SINGLE-AUTHOR!
                 (CHR[L+1] = ' ') AND (CHR[K] = ',') THEN IF  !WORKS 1ST!
                 (CHR[K+2] = 'e') OR (CHR[K+2] = 'a') OR
                 (CHR[K+2] = 'w') THEN FLAG := 0;

              IF (CHR[L] = '.') AND (CHR[L+1] = ' ') AND
                 (CHR[L+2] = ' ') AND (CHR[K] = ',') THEN IF
                 (CHR[K+2] = 'e') OR (CHR[K+2] = 'a') OR
                 (CHR[K+2] = 'w') THEN FLAG := 0;

              IF (CHR[K-1] = '.') AND (CHR[K] = ' ') AND
                 (CHR[K+1] = ' ') AND (CHR[L] = ',') THEN IF
                 (CHR[L+2] = 'e') OR (CHR[L+2] = 'a') OR
                 (CHR[L+2] = 'w') THEN FLAG := 1;

              IF (CHR[K] = '.') AND (CHR[K+1] = ' ') AND
                 (CHR[K+2] = ' ') AND (CHR[L] = ',') THEN IF
                 (CHR[L+2] = 'e') OR (CHR[L+2] = 'a') OR
                 (CHR[L+2] = 'w') THEN FLAG := 1;

              IF (CHR[K] = 'a') AND (CHR[K-2] = ',')      !ED. WORKS NEXT!
                 AND (CHR[L] = 'e') THEN FLAG := 0;
              IF (CHR[K] = 'e') AND (CHR[K-2] = ',')     !MULTI-AUTH LAST!
                 AND (CHR[L] = 'a') THEN FLAG := 1;
           END;

         IF FLAG = 1 THEN
           BEGIN                                      !ADJUST ADDRESSES!
             ENTRYADD[J+1] := ENTRYADD[J];             !AS NECESSARY!
             IF J >= 1 THEN J := J - 1;
             IF J = 0 THEN FLAG := 0;
           END;
       UNTIL FLAG = 0;
       ENTRYADD[J+1] := TEMP;
    END;
    WRITE('Sort Finished!',BELL);
END;

!----------------------OUTPUT TITLE AND/OR FIRST ENTRY----------------------!

PROC SENDTITLE;

    VAR P, Q : INTEGER;

    BEGIN
       IF TITLEFLAG = 1 THEN FOR P := 1 TO TITLEEND DO
            BEGIN
               IF (COMMAND = 'V') OR (COMMAND = 'v') THEN WRITE(TITLE[P]);
               IF (COMMAND = 'P') OR (COMMAND = 'p') THEN
                 IF TITLE[P] <> '*' THEN PRINT(TITLE[P]);          !STRIP '*'!
               IF (COMMAND = 'W') OR (COMMAND = 'w') THEN PUT(TITLE[P]);
            END;
       Q := ENTRYADD[1];                                  !POINT TO FIRST ENTRY!

       REPEAT                                              !OUTPUT FIRST ENTRY!
          IF (COMMAND = 'V') OR (COMMAND = 'v') THEN WRITE(CHR[Q]);
          IF (COMMAND = 'P') OR (COMMAND = 'p') THEN PRINT(CHR[Q]);
          IF (COMMAND = 'W') OR (COMMAND = 'w') THEN PUT(CHR[Q]);
          Q := Q + 1;
       UNTIL (CHR[Q-1] = NL) AND (CHR[Q-2] = NL);
    END;
```

→

```
!------------------------------OUTPUT EACH ENTRY-------------------------!

PROC SENDFILE;                    !'M' PASSES ENTRY ADDRESS TO OUTPUT ROUTINE!

     BEGIN                                              !MAIN OUTPUT ROUTINE!
        REPEAT
          IF (COMMAND = 'V') OR (COMMAND = 'v') THEN WRITE(CHR[M]);
          IF (COMMAND = 'P') OR (COMMAND = 'p') THEN PRINT(CHR[M]);
          IF (COMMAND = 'W') OR (COMMAND = 'w') THEN PUT(CHR[M]);
          M := M + 1;
        UNTIL (CHR[M-1] = NL) AND (CHR[M-2] = NL);      !STOP AT END OF ENTRY!
     END;

!---------------------------PROCESS FILE AS DIRECTED-----------------------!

PROC MUGATO;

   VAR I, J, K, L, NAMEEND, FLAGA, FLAGB, FLAGC, FLAGD, RETURN : INTEGER;

   BEGIN
      IF (COMMAND = 'W') OR (COMMAND = 'w') THEN                !GET FILE NAME!
         BEGIN                                                   !IF NEEDED!
            WRITE(NL,NL,NL,'Output File Name');
            REWRITE('?');
         END;

      IF (COMMAND = 'V') OR (COMMAND = 'v') THEN WRITE(ESC,'E');

      SENDTITLE;                                  !OUTPUT TITLE AND/OR FIRST ENTRY!

      FOR I := 2 TO ENTRYNUMB DO                   !FOR 2ND AND LATER WORKS, CHECK!
         BEGIN                                   !FOR MULTIPLE WORKS BY SAME AUTHOR!
            J := ENTRYADD[I]; K := ENTRYADD[I-1]; NAMEEND := Ø;
            FLAGA := Ø; FLAGB := Ø; FLAGC := 1; FLAGD := Ø;

            IF (MULTIPLE = 'N') OR (MULTIPLE = 'n') THEN
               BEGIN
                  REPEAT
                        IF (CHR[J] <> CHR[K]) THEN FLAGA := 1;   !NAMES DIFFER!
                        IF (CHR[J] = ';') THEN FLAGB := 1;    !MULTIPLE AUTHORS!
                        IF (CHR[J] = ',') AND (CHR[J+1] = ' ') AND        !and!
                           (CHR[J+2] = 'a') OR (CHR[J+2] = 'w')      !or with?!
                           THEN FLAGB := 1;

                        IF (CHR[J+1] = '.') AND (CHR[J+2] = ' ') AND   !END OF!
                          (CHR[J+3] = ' ') THEN                        !NAME FOUND!
                             BEGIN
                                IF (CHR[K+1] = '.') AND (CHR[K+2] = ' ')
                                   AND (CHR[K+3] = ' ') THEN FLAGC := Ø;
                                IF (CHR[K+1] = ',') AND (CHR[K+2] = ' ')
                                   AND (CHR[K+3] = 'e') THEN FLAGC := Ø;
                                IF (CHR[K+1] = '.') AND (CHR[K+2] = ',')
                                   AND (CHR[K+3] = ' ') AND (CHR[K+4] = 'e')
                                   THEN FLAGC := Ø;
                                FLAGD := 1;
                             END;
                        IF (CHR[J+1] = ',') AND (CHR[J+2] = ' ') AND  !END NAME!
                          (CHR[J+3] = 'e') AND (CHR[J+4] = 'd') THEN     !(ed.)!
                             BEGIN
                                IF (CHR[K+1] = '.') AND (CHR[K+2] = ' ')
                                   AND (CHR[K+3] = ' ') THEN FLAGC := Ø;
                                IF (CHR[K+1] = ',') AND (CHR[K+2] = ' ')
                                   AND (CHR[K+3] = 'e') THEN FLAGC := Ø;
                                IF (CHR[K] = '.') AND (CHR[K+1] = ' ')
                                   AND (CHR[K+2] = ' ') THEN FLAGC := Ø;
                                FLAGD := 1;
                             END;

                        J := J + 1; K := K + 1;
                  UNTIL FLAGD = 1;

                  IF (FLAGA = Ø) AND (FLAGB = Ø) AND (FLAGC = Ø) THEN
                    BEGIN                                 !IF NEEDED, PUT UNDERLINE!
                      NAMEEND := J - ENTRYADD[I];          !CHARACTERS IN PLACE!
                      FOR L := 1 TO 8 DO                     !OF AUTHOR'S NAME!
                        BEGIN
                          IF (COMMAND = 'V') OR (COMMAND = 'v') THEN WRITE('_');
                          IF (COMMAND = 'P') OR (COMMAND = 'p') THEN PRINT('_');
                          IF (COMMAND = 'W') OR (COMMAND = 'w') THEN PUT('_');
                        END;
                    END;
               END;

            M := ENTRYADD[I] + NAMEEND;       !SET POINTER 'M' TO ENTRY ADDRESS!
            SENDFILE;                                      !OUTPUT NEXT ENTRY!
         END;

      IF (COMMAND = 'P') OR (COMMAND = 'p') THEN PRINT(EOF);   !DUMP LP: BUFFER!
      IF (COMMAND = 'W') OR (COMMAND = 'w') THEN PUT(EOF);     !CLOSE DISK FILE!
```

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until different characters are detected, then orders them accordingly. The trickiest thing is handling the special alphabetizing cases.

The key to the specialized cases is SMARTSRT's ability to compare characters at *different* points in each entry, using a "comparison pointer."

For example, in the case of anonymous works, an initial article must be ignored; therefore, the first entry below should come after the second:

A Survey of Great Climbing Feats, 1850-1900. Boston: White Mountain Press, 1972.

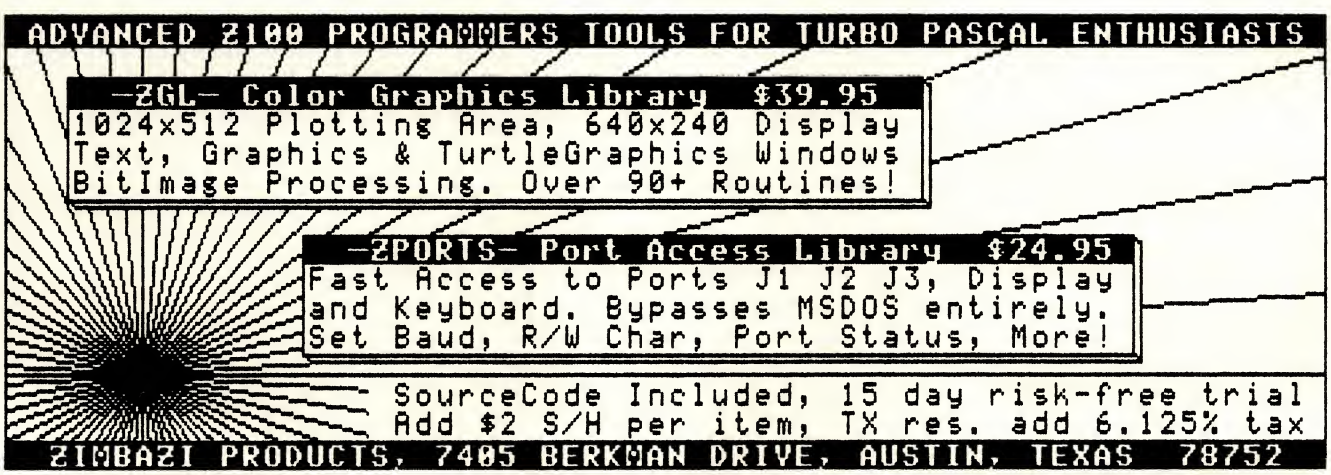
Elston, Joan. First Steps in Rock Climbing. Denver: Mountaineering Press, 1981.

First, the SORT procedure detects the article "A ". (Note the following space—so it isn't just the first letter of a word.) Then, the comparison pointer is moved past the two characters, "A" and the space. This is done by defining an "offset" (OSETA and OSETB for the first and second entries being compared, respectively). Then the first significant word in the anonymous entry ("Survey") can be compared with the author's name for the next entry ("Elston").

A similar technique is used to handle the articles "An " and "The " and author names beginning with "Mc" or "Mac", as well as the quotation marks which enclose journal entries. If the first significant character of each entry is equal to that of the entry it's being compared to, then the entries are scanned until different characters are encountered. During this process, initial articles are offset by the procedure OFFSET.

To allow for edited and co-authored works, each entry is scanned for "e" (as in "ed."), "a" ("and"), and "w" ("with") following a space and a comma. (Check Figure 1 to confirm that these indicate such works.) If these are detected, edited works are placed after any single-author works by the same person; co-authored works follow last. This is done by setting FLAG = 0 (don't exchange addresses) or FLAG = 1 (exchange addresses) as each comparison is made.

```
      IF (COMMAND = 'V') OR (COMMAND = 'v') THEN
         WRITE(NL,NL,'------------------------');

      IF TITLEFLAG = 1 THEN                                  !CONSUMER INFORMATION!
         WRITE(NL,'Title with ',TITLEEND#,' characters, and ');
      WRITE(NL,'Text with ',ENTRYNUMB#,' entries and ',CHRNUMB#,' characters');
      WRITE(' processed.',NL,NL,'Hit <RETURN> to continue ');
      CONCL;
      READ(RETURN);
      WRITE(ESC,'E');
   END;

!-------------------------------------MENU---------------------------------!

PROC MENU;

   BEGIN
      WRITE(ESC,'Y',36,57,'View File           =  V');
      WRITE(ESC,'Y',37,57,'Print File on LP:   =  P');
      WRITE(ESC,'Y',38,57,'Write File to Disk  =  W');
      WRITE(ESC,'Y',39,57,'Select New File     =  CNTRL-C');
      WRITE(ESC,'Y',40,57,'Quit (to HDOS)      =  CNTRL-A');
      WRITE(ESC,'Y',42,57,'Select Function:    =  ');

      REPEAT                                                 !INPUT CORRECT?!
        CONCL;
        READ(COMMAND);
        IF (COMMAND <> 'V') AND (COMMAND <> 'v') AND (COMMAND <> 'P') AND
          (COMMAND <> 'p') AND (COMMAND <> 'W') AND (COMMAND <> 'w') THEN
              BEGIN
                WRITE(NL,NL,'                          Incorrect input.');
                WRITE(' Please try again.  Function  =  ');
              END;
      UNTIL (COMMAND = 'V') OR (COMMAND = 'v') OR (COMMAND = 'P') OR
       (COMMAND = 'p') OR (COMMAND = 'W') OR (COMMAND = 'w');

      WRITE(NL,NL);
      WRITE('                          Repeat authors name');
      WRITE(' in multiple works (Y/N?): ');
      REPEAT
        CONCL;
        READ(MULTIPLE);
        IF (MULTIPLE <> 'Y') AND (MULTIPLE <> 'y') AND
          (MULTIPLE <> 'N') AND (MULTIPLE <> 'n') THEN
              BEGIN
                WRITE(NL,NL,'                                  Incorrect input.');
                WRITE(' Please try again (Y/N?): ');
              END;
      UNTIL (MULTIPLE = 'Y') OR (MULTIPLE = 'y') OR
       (MULTIPLE = 'N') OR (MULTIPLE = 'n');

      MUGATO;                                          !TO MAIN PROCESSING LOOP!
      MENU;                                                !RETURN TO MENU!
   END;

!-------------------------------MAIN PROGRAM-----------------------------!

BEGIN
   HEADER;
   GETFILE;
   SORT;
   MENU;
END.
```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After the SORT, the MENU procedure is run. Basically, your responses to the MENU define the global variables COMMAND and MULTIPLE, which control the outputting of the file.

Additionally, there are routines to trap inputs not allowed by the menu. Then control passes to the procedure MUGATO. (The name is a trade secret, but *Star Trek* fans take note.)

If you have chosen to write the file to disk, you will be prompted for a file name. SENDTITLE checks (through the variable TITLEFLAG) whether there is a title. If so, it will be sent to the screen, printer, or disk as determined by the value of the variable COMMAND. (Note that the print routine removes the "*" title marker.) SENDTITLE then outputs the first entry of the file.

The procedure MUGATO then checks for edited or co-authored works by searching for the appropriate character patterns. It also scans the author's name and compares it with that of the previous entry; if the two are the same, eight "_" characters are substituted for the author's name for second and subsequent entries. The multiple-works feature can be disabled by setting the variable MULTIPLE to "N" (or "n").

Next, the global variable M is set to the next ENTRYADDress, and the procedure SENDFILE is called to output the next entry. This continues until the final entry is done.

When necessary, an end-of-file character is sent to the printer (to flush the print buffer) or to the disk drive (to tell HDOS to close the file), and a message is printed indicating whether a title was present and how many characters and entries were processed. Finally, the MENU is called again.

Known limitations and cautions

Tiny Pascal is faster than BASIC and takes less memory—but you can still run out.

Regarding memory, the critical factor is how the CHR, ENTRYADD, and TITLE arrays are dimensioned at the start of SMARTSRT.PAS. What will work depends on how much memory you have and the drivers you want to load. The sizes given in Listing 1 (CHR = 11000, ENTRYADD = 200, TITLE = 200) run in my 56-kilobyte machine with HDOS 2.0, SoftShop's Super Sysmod, and 3.5K of additional device drivers.

Theoretically, your file could be as big as CHR, the array which holds it. I have compiled SMARTSRT, which is 49 sectors long, with CHR dimensioned up to 11,000 elements before getting "Stack Overflow" messages. This should hold at least a 10K file—or about six pages of bibliography.

Those values may or may not work for your situation. If you get the dreaded "Stack Overflow" message when you try to load SMARTSRT.ABS, you will have to reduce the size of CHR until the program fits. But once you find array sizes that work for you, keep your text within them! If you try to input a file that's too big, or has too many entries or too long a title, you will get unpredictable results, and may end up having to RESET your whole system.

You may find a few "application notes" helpful in using SMARTSRT.

First, remember to enter two RETURNs after the *last* item in your file, as well as after all the others. Otherwise, SMARTSRT doesn't know it's an entry, and it will be lost when the rest of the text is processed.

Second, remember that SMARTSRT doesn't reformat material when outputting it, except for replacing the underline characters with the author's full name. When you enter the material in second and subsequent references, leave room for the full name to be printed on the line if you want it "expanded" when output.

Third, SMARTSRT does not erase the old file before writing the new one. When writing a sorted file back to the same disk, remember that there must be room to re-write the file, and the new (sorted) file must have a different name. You can use the same name when writing to a *different* disk.

Finally, remember to follow the title format. The initial "*" must be the *first* character in the file.

Thus, this is a valid title:

```
*                BOOKLIST*
```

while this is not:

```
                 *BOOKLIST*
```

since the line begins with spaces. Again, the initial "*" must be the *first* character in the file.

Conclusion and reflections

I hope you find SMARTSRT helpful in a variety of special sorting situations. Its capabilities make it useful to those who deal with blocks of text and are tired of trying to make typical line sorts work, or having to adapt data base printout routines to their own format.

SMARTSRT also illustrates how text-file operations in Tiny Pascal can be customized to deal with almost any situation. If these routines do not fit your exact needs, I hope you will feel free to experiment.

The point is not to create some "universal" program, but to illustrate techniques to help you get what you need rather than what your computer needs!

This leads to the final thought that "computerphobia" is usually a software problem, not a hardware problem. People are intrigued by the computer itself, but angered by the annoying and apparently arbitrary limitations that the typical software places upon their work. And this includes programs described by that much-abused term "user friendly."

All too often, "user friendly" means only that a few extra menus are provided. What it *should* mean is that I can work with my own material, in my own format, instead of conforming to artificial requirements imposed by software.

Even a "perfect" sorting program is useless if it cannot handle your material in the format which you require.

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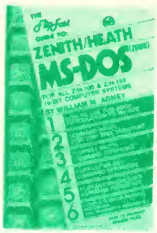

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IBM Emulation with the Gemini Board

A look at one approach to giving the Z100 the option of running software designed for the IBM Personal Computer.

Wayne Rash, Jr.

It wasn't long after the H/Z100 was introduced four years ago that users began asking the question: "Why won't my Z100 run all that IBM software?" To some extent, the problem was mitigated by Zenith's efforts to provide software that was equal to or better than that available for the IBM Personal Computer. Nevertheless, the presence of Big Blue was too much to ignore, and the cry continued.

Eventually, the questions turned to the best way to make the '100 compatible with a computer that was slightly less capable, slightly slower, but with a considerably larger base of software support. There was just too much interesting software out there, and the users wanted some of it.

When the '100 was first introduced, less than a year after the IBM, many people did think it was compatible. After all, both machines ran the same operating system. The Zenith Disk Operating System (Z-DOS) was just Zenith's implementation of version 1 of the Microsoft Disk Operating System (MS-DOS); similarly, PC-DOS was just IBM's implementation of MS-DOS 1. Moreover, both computers used the same disk format. Any programs that were written to use standard operating-system calls, and did not have characteristics specific to the IBM screen, should have run fine on the '100.

And at first, much of what was available did run fine. The first of the important software vendors translated their programs from CP/M versions, and the same screen characteristics that they had provided to support the H/Z89 worked on the '100. For a company that had seen the success of industry-wide compatibility through CP/M, this must have seemed a logical course. Unfortunately, logic lay abandoned by the vagaries and needs of the marketplace.

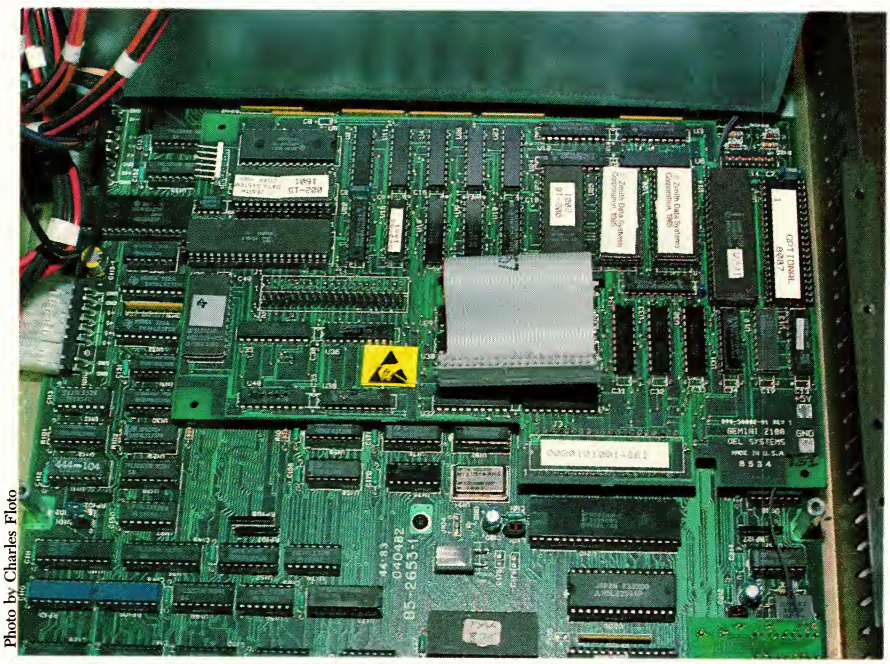

Photo by Charles Floto

The catch was: "characteristics specific to the IBM screen." Modern software is heavily screen oriented; MS-DOS was crippling in this respect. Under plain-vanilla MS-DOS, for instance, programmers had to be satisfied with the block-graphics symbols available to CP/M and older computers like the H/Z89.

So programmers wrote code that went around MS-DOS and talked to the IBM screen directly. Moreover, besides MS-DOS's screen limitations, it was slow. There was just too great a temptation for programmers to go around it.

(For more on this, you might want to see if you can find a copy of *Sextant* #9, March-April 1984. There, Graham Wideman addressed the question, "Why Won't All That IBM Personal Computer Software Run on My Z100?" Unfortunately, *Sextant* has run out of copies of that issue.)

Plug-in compatibility

Sometime in early 1984, the problem of IBM compatibility attracted the attention of the people at Gemini Technology, Inc. (then called D.E.L. Professional Systems). They began thinking about intercepting the operations of the computer at the level of the central processing unit (CPU); in that way, IBM emulation could be switched in and out efficiently and with a minimum of hardware.

The engineering involved in this sort of operation is very complex, and it took nearly a year and a half (until the fall of 1985) before the first commercial version of the Gemini Emulator Board was released to the public.

The concept called for the board to plug into the CPU socket, and that's what the Gemini board does. It also plugs into a video connector, since much of the IBM PC's difference is in the way it handles its screen.

Wayne Rash, Jr., is a consultant with American Management Systems in Arlington, Virginia. He's also a freelance writer; his articles appear in magazines such as Byte *and* PC Week.

Running the Gemini board

When you boot an H/Z100 equipped with the Gemini board, you decide whether you're going to run the machine in its native mode, or whether you're going to emulate an IBM PC. As the system is powered up, the Gemini logo is displayed on the screen; beneath it, a menu tells you to press "Z" to run your system as an H/Z100, or "I" to emulate an IBM PC. Choosing the "Z" causes the computer to boot and operate as a normal H/Z100.

If you make the "I" choice, you will see the prompt for the Zenith 150 monitor. Gemini, it turns out, has licensed the code from the Z150 monitor routines for use in its read-only memory (ROM). As a result, you get the versatile ROM-based programs and diagnostics that come with Zenith's IBM-PC clones. In order to boot the operating system, you must press "B". Automatic booting does not appear to be available.

A '100 equipped with the Gemini board will load and run MS-DOS version 2.11 for the Z150, as well as versions of MS-DOS for most other IBM-compatible microcomputers. I was able to confirm that it will run operating systems from Tandy, Xerox, and AT&T, as well as from IBM.

What works

Almost all software for IBM-PC compatible computers will run on a '100 equipped with a Gemini board. This includes some software that is extremely machine specific. Two of my favorite tests for compatibility, Microsoft's Flight Simulator and Ashton-Tate's Framework, ran fine.

One exception is Digital Research's Concurrent PC DOS, the version of Concurrent DOS for the IBM. It wouldn't work on the Gemini board.

For the most part, though, the only problems I had were with communications software. You are going to have problems with any modem program that addresses the IBM serial-communications chip directly, and most communications software does this. I was not able to get my copy of PC-Talk to operate properly, and Cullinet's Infogate did not have complete functionality. Polyterm from Polygon Associates would run just fine, but would crash when I told the program to exit to the operating system.

The method used by the Gemini board to paint the screen can cause a few strange results with some software. Instead of simply flashing a completed screen before you, as is done with the IBM, you see the screen created from the top down. This process is very quick; but in some circumstances it can be distracting, especially when there is rapid scrolling. In that case, the text being put on the screen is mixed with text already there. This clears up when scrolling stops.

Otherwise, there is little drama to operating the '100 with a Gemini board installed. There are a few differences from the IBM clones, though.

You're going to have to do without variable intensity, since this is not supported by the Gemini board. This can be a problem with some software that uses high intensity to indicate menu choices and the like. You must also do without sound until an additional board is released. The sound board has been designed, and was included with my review unit. It worked quite well.

Installing the Gemini emulator board

This is another one of those projects where you're going to have to take your computer apart. The Gemini board attaches to your H/Z100's motherboard, and you have to clear things away until you get to that. A pamphlet that comes with the Gemini board explains this in more detail.

The precise steps will depend a little on whether you have a '110 or a '120, and whether you have a hard disk installed. I will outline the steps here, but you should refer to the manual that came with your '100 if you have doubts about your ability to do this.

Your first step is to take the cover off the computer. This involves moving two metal slides back and forth until something gives. Depending on the specifics of your system, that something might be your patience. By whatever method you free it, lift the top of the computer clear, and place it aside until later.

If you have the all-in-one version, you will notice cables connected to the disk drives, and another cable that attaches to a circuit board to the left of the cathode-ray tube (CRT). You need to unplug the cables from the disk drives, marking them with a piece of masking tape if necessary. You also need to unplug the cable from the video board next to the CRT. You do this by releasing the clip which holds it in place and pulling it off. You'll need a screwdriver to release the clip.

Once the cables are disconnected, you need to remove the screws holding the top half of the computer to the bottom. This will allow you to remove the top portion, and to set it aside. In the all-in-one version, you will have a sub-chassis containing the CRT and the disk drives. The low-profile version will contain only the disk drives.

Once the upper section is removed, you will be confronted with the keyboard bezel, which is a piece of plastic that covers the keyboard and extends along the sides of the computer. You'll need to remove two screws to free this, and then you can set it aside.

The keyboard is now resting on its foam shock absorbers, but is not fastened down. Move it forward to expose the plugs that attach the keyboard to the

IBM PC Emulation Strategy

It is possible to make a Z100 behave like an IBM Personal Computer. It's even possible to make it happen fairly effectively. There are three products that I will be reviewing in *Sextant*, and they each take a different approach to solving this problem.

Briefly, the approaches can be described as hardware-only, hardware/software, and software-only. These are loose descriptions, but they will do to set the methods apart. You should note that nothing in these descriptions is absolute. The hardware approach does require some software, and the software approach can use some additional hardware to good advantage.

The UCI EasyPC board is the most hardware-oriented product. Essentially, it is like putting an IBM-PC clone inside your Z100, and using the peripherals for support. This is why the product consists of three circuit boards and a wiring harness. Because all of the work is done by hardware, the UCI method produces the fastest machine, and the most effective screen handling.

The Gemini emulator board makes very heavy use of ROM-based software, and it has its own CPU just to handle the emulation. This results in much less hardware being used, easier installation, lower cost, and probably more effective emulation. The use of software for much of the emulation does result in slower operation, but it also means that problems can be corrected sooner. As Motorola's Bill Lucas once said, "Nobody's ever come up with an editor for hardware."

The Heath Users' Group's ZPC takes the software-only approach. As with the Gemini board, this makes it easy to update, but there are limits to what software alone can accomplish. In this case, the result is less effective emulation, which means that you may have to patch some software so that it will run with ZPC. The addition of some hardware to the Z100 will help this system. The software-only approach does have an advantage in flexibility, since it is simply a program which is called as needed.

motherboard, then unplug it. Set the keyboard aside also.

The video board is mounted above the motherboard on three spacers. Use a small Phillips screwdriver to remove the three screws that hold it in place. Once this is done, unplug the cable on the left from the motherboard and the cable on the right from the video board. Set the video board aside.

Attaching the Gemini board

Before you install the Gemini board, you must remove the 8088 CPU from the motherboard at location U214, and install it on the the Gemini board. For best results, you should use an integrated-circuit extraction tool. If you don't have one of these, use the sheet metal chip-puller that accompanies many Heathkit products. You can also use a thin screwdriver or a pocket knife to carry out this operation, but you need to be more careful. If you pull the CPU chip out unevenly, you'll need to straighten its pins before continuing.

Once the CPU is freed from the motherboard, it should be inserted into location U11 on the Gemini board. Check that the chip is oriented properly, and that you didn't bend any pins when you inserted it.

(Note that there is a socket alongside the CPU for an 8087 math co-processor. The Gemini board will support operation of the 8087 in either the IBM or the Z100 mode.)

You plug the Gemini board into the motherboard by inserting a 40-pin connector into the socket vacated by the CPU, and by plugging a socket over the location formerly occupied by the left video cable.

That last operation is very tricky, since you can't see the plug where the video cable was well enough to make sure that it is located properly. I had to squint between the Gemini board and the motherboard to make sure I was doing it right. And even then, I missed it the first time. You may find that using a flashlight will help you get it right the first time.

Once the Gemini board is plugged in, most of the difficult work is done. You still have to re-attach the plugs to the video board, and you have to reassemble the computer. I recommend that you stop reassembly once your computer is far enough along that it will operate, so that you can test the board. This will save you some disassembly time if it turns out that you put something together wrong.

Checking it out

All you have to do to see if you installed the Gemini board properly is turn the computer on.

Once the computer begins running, you will see the Gemini logo, and below that the menu that tells you how to select the mode of operation. If this all appears, then the board should be operating properly. To make sure, select the IBM mode and insert a Z150 MS-DOS system disk into drive A:. If you did everything right, the disk will boot, and your computer will be running as if it were a '150.

Documentation

If there is an area where the Gemini board is deficient, this is it. There is no manual as such. There is a card to tell you how the keys are mapped when you are in the IBM mode, and a pamphlet that gives installation instructions. There are a few instructions that tell you how to prepare your hard disk, and a discussion of the hardware requirements.

These instructions are adequate to allow a knowledgeable user to install and operate the Gemini board. However, an inexperienced user may well have problems—as I found when I tried the instructions on a user who was fairly new to computing, but who was experienced enough to have built her own '100. Most of the problem is that the drawings are very small, and part locations are not always shown clearly.

Other items that are notably missing are a troubleshooting guide, a discussion of the theory of operation, and some sort of guide indicating the level of compatibility. Fortunately, there is very little to operating this board. As a result, the lack of a comprehensive manual is not as crippling as it could be with some other products.

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Should I buy one?

If you want to run IBM or Z150 software, and you don't want to buy another computer, this product or one like it is about your only choice. On the other hand, if you have the space and a little more money, another computer may be a more attractive answer.

The Heathkit stores frequently sell the kit version of the H/Z148 for about $900—which is not a great difference when compared with the Gemini board's $599 price tag. (The assembled version of the Z148 costs $1,299.) In addition, the '148 gives you near-perfect compatibility, as well as operation that does not remind you that this was a compromise.

Of course, if you can get the Gemini board at an acceptable discount, it becomes much more attractive. This is especially true if your '100 has a hard disk that you want to use with IBM software. In this case, though, you should be aware that you must devote a separate partition to the Gemini board, since IBM-PC software cannot read the '100's hard-disk format.

You will have to remove the software from your hard disk and use MS-DOS's PART utility to create a partition for the use of IBM software. Neither the Z100 mode nor the IBM mode will be able to read the other's disk partition. This means that you cannot share information on the hard disk between the two systems.

Conclusions

In general, I was pleased with the overall operation of the Gemini board in areas related to compatibility. Software ran as it was supposed to, speed was reduced only slightly, and there were few unpleasant surprises.

There were a few problems during the review. The first Gemini board I tried did not operate, but I suspect that I installed it incorrectly. It later worked all right on another machine. The second did operate properly, but died after two weeks. (I suspect a bad chip, there.) Authorized dealers, including most Heathkit stores, will be able to repair your Gemini board if this happens to you.

If you need compatibility with the Z150 (or the IBM), the Gemini board is a solution worth considering. Installation of the board has no impact on Z100 operations, and it runs IBM software quite well. Still, there are compromises, most notably in communications.

That there are so few compromises is remarkable. Provided the board meets your needs—and it should for most people—you should be happy with it.

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The Spirit of St. Louis

Yes, Virginia (and California), there is a third regional conference for users of Heathkit and Zenith Data Systems computers.

Kieran P. O'Leary

St. Louis is well known for several reasons: It is home to the famous Anheuser-Busch breweries, the Cardinals, and the arch which proclaims the city as "Gateway to the West." Now, some will associate St. Louis with the Midwest Heath Users' Group Conference—held May 2-4, 1986 in Bridgeton, Missouri. The first conference sponsored by the St. Louis Heath Users' Group did not draw as many attendees as the organizers had hoped; but the enthusiasm of the vendors and users remained high. Most of the people I spoke with had an enjoyable time, despite the moderate showing. St. Louis HUG president Jeff Lines assured the audience at the closing question-and-answer session that there would, indeed, be a second Midwest HUGCON.

Thirteen vendors had booths in the exhibit area: C.D.R. Systems, Al Davis, EWDP Software, First Capitol Computer/Software Wizardry, Floppy Disk Services, Gemini Technology, Graymatter Applications Software, St. Louis HUG, national HUG, Kres Engineering, Sextant Publishing Company, UCI Corporation, and Barry A. Watzman. Some celebrities (of the Heath/Zenith world) took time to make an appearance—including Joe Schulte, president of Veritechnology Electronics Corporation (which runs the local Heath/Zenith stores), Bob Ellerton, manager of national HUG, and the rather mechanical but somewhat cute HERO Jr. I learned a lot, not only about computers, but also about the meaning of spirit, and in no more appropriate a place than St. Louis.

It was difficult for us to go anywhere outside of the Henry VIII Inn & Lodge, in Bridgeton, since concrete barriers blocked passage across the highway. So, we had to settle for the amenities of the hotel. The room John Gill, our assistant publisher, and I shared was quite big, and had a refrigerator, two televisions (both with remote control), and a shower massage. Too bad they didn't leave us enough towels. The inn has indoor and outdoor pools, a jacuzzi, a sauna, and several Nautilus machines. I guess all of that made up for not getting to see the arch.

Friday evening, the vendors attracted few customers. The anticipation seemed to grow as people awaited the arrival of the masses. No one seemed to know how many people were expected, and preregistrants were not required to pay a fee until they actually showed up, leading me to believe there was little incentive to do so on their part. Still, there were busy periods throughout the weekend, and the banquet Saturday night actually drew about 200 people, so the effort wasn't wasted.

> ***"HUG. . . serves a valuable function for the Heath/Zenith community."***

Attending the talks

On Saturday, I attended several of the lectures given by representatives of the Zenith community and other knowledgeable experts. The first I attended was "HUG Software—What You're Missing!", given by national HUG's Jim Buszkiewicz. Jim is a relaxed, entertaining speaker, and his hour-long presentation did not drag or stagnate.

During his talk, Jim showed slides of various new programs available to users. Some of these are public domain software; others are "shareware." (With shareware, the creator retains the copyright; the program may be free to individuals, but you can't distribute it commercially without permission.) Jim did not distinguish between the two, so if you're interested in finding out a program's status, you should contact HUG.

A large number of the new programs presented are video games. They include NOVATRON, an adaptation of themes from the movie *TRON*; it's available for H/Z100 systems running the Microsoft Disk Operating System (MS-DOS) (and it can be modified to run on the H8 and H/Z89). Also for use on the '100 are Dungeons & Dragons, Worm, Elevator, and Pango.

The video game I found most interesting, though, was Sea Battle, because it was the only one written in assembly language. I give the developer credit for spending the time and effort to write it. According to Jim, this program runs under CP/M on the H8, H89, and Z100 with H19 graphics. It just goes to show there is something for everyone in software.

I found several other programs noteworthy for their special functions. For example, Grade is an applications program for teachers; it replaces the roll book, and can keep track of pupil rosters, test marks, and any other function which a roll book serves. Developed by Professor Robert R. Ludeman, Grade runs on the '100 and '89 under CP/M, and on the '150 under MS-DOS.

Two of the more highly specialized packages available are NAVPROGseven for pilots (runs on the H8/H89; now available for the '100 and '150) and RFCAD for antenna designers (for '100, '150, and '200 systems and for CP/M).

One which I thought was interesting is Skyviews. Written by a college student, it is a program for astronomers that allows you to plot the positions of the constellations in the heavens by using predetermined altitudes, azimuths, and orbits on a certain day and time. One feature allows the user to view the heavenly bodies close up, giving the screen a telescope effect. It just goes to show how far college students have progressed.

The two programs Jim described as "selling like hotcakes" are MS-DOS HELP and ScreenSaver Plus. MS-DOS HELP is a utility program that lists all the commands available to the user under MS-DOS versions 2 and 3. The user positions

Kieran O'Leary is a Sextant *employee and editorial/production assistant for* Buss *newsletter. He also does freelance translation in the Spanish and Italian languages. Originally from Brooklyn, he's a graduate of New York University.*

Photo by Charles Floto

Dr. David Cheung (center) answered many questions about UCI's EasyPC for the Z100.

the cursor on the command, and the screen will display a description of the command and how it is used. ScreenSaver (one of the utilities on the ScreenSaver Plus disk, described in the May 1986 *REMark*), is also a utility program; it allows blanking the screen after a specified period of time to avoid burnout of the screen's phosphors.

Most of these programs are listed in the HUG Software Catalog; others can be accessed through the HUG Bulletin Board (616/982-3956). The bulletin board runs on a '150 with a 20-megabyte Winchester. Of the available storage space on the bulletin board, 1.5 MB goes to '100 programs and 7 MB to Heath/Zenith's IBM compatibles. (This may give you an idea of where program development is headed.) The rest of the space goes to programs for the older Heath Disk Operating System (HDOS) and CP/M.

Meeting the HUGgies

After my first lecture, I went back to the booth for a while and met some HUGgies. Most people who stopped by were familiar with *Buss* and *Sextant*. They were happy that we have chosen to stay Heath/Zenith-specific in the midst of IBM-PCmania. Some were hopeful that HUG support would continue to grow.

Bob Ellerton seemed to confirm that hope on Saturday when an audience member asked what HUG's future was. "Jerry Pearlman, chairman of the board of Zenith. . ., likes HUG," Ellerton said. "It serves a valuable function for the Heath/Zenith community."

Testing the waters

Sam Morgan, an engineer with McDonnell Douglas, presented the "C Programming Language." Sam began with a brief history of C, which was developed by Dennis Ritchie of Bell Labs in the early 1970s.

Addressing C's relative difficulties for programmers of other languages, Sam pointed out that Pascal users would recognize syntactical differences; assembly-language users would find elements of Pascal and assembly language; while FORTRAN users (and I) could consider C a new language.

I began to take notes, but soon found a lot of the technical material beyond my grasp. What I learned, however, is that the C language currently uses only 27 key words, as well as a powerful set of operators, allowing greater speed and efficiency in programs.

It is also a structured language (like Ada and Pascal), unlike FORTRAN, which relies on GOTOs and arrays. Its compilers are small and efficient, something a microcomputer user will find important, since it conserves memory. To illustrate its compactness, Sam said that while using a Unix system, he ran a program which used 50 kilobytes under FORTRAN, but only 14K under C.

Another advantage to C is what Sam called its "ROM-ability." Many programs cannot be stored in read-only memory because their temporary storage is allocated in the same area as the program, and temporary storage cannot be read-only. C avoids this problem by using a stack in user memory for its temporary storage. This may be important to systems programmers who need to write code for production purposes.

One other important point—Sam recommended that when you write programs, use a lot of white space (blank space) wherever it would enhance readability. This may seem odd to a programmer familiar with, say, BASIC, where spreading the program over more lines may slow down operation; that's not the case in C.

Programmers will find *The C Programming Language*, by Dennis M. Ritchie and Brian W. Kernighan, a useful guide.

Taking a breather

After digesting this heavy material, I decided to wash it down with some real food at the inn's restaurant. The considerably overworked waitress recommended the Crepes Henry VIII, which were quite tasty. Janet Stotts, *Sextant*'s ad manager, and I decided that a glass of house wine would be a good tonic to end lunch with. Armed for battle with my tape recorder and pen and pad, I marched off to hear Hilgraeve Inc.'s Matt Gray on "Telecommunications Using Micros."

Matt is an effective speaker as well as a sharp businessman. Promoting his modem package, HyperACCESS, Matt asked the audience if anyone owned a copy of his earlier program, ACCESS. "Surprisingly few," Matt responded to the lack of raised hands. From there, he

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pointed out the features of HyperACCESS that make it a versatile telecommunications package.

HyperACCESS runs under Z-DOS and MS-DOS on the '100 and '150, and is menu driven. It has interruptible menus, so the user can perform other commands and return at any time to the menu. It can interface with virtually any other type of terminal, whether mainframe, minicomputer, or microcomputer. It can receive data regardless of the program it is hooked up to. Incoming phone calls can be logged into a file to be accessed later by the user.

Matt advised that the minimum memory requirement for this program is 128 kilobytes, but that it runs optimally with 256K.

Speaking my language

A team from the St. Louis division of Apple presented the next talk I attended. (The local Heath store sells Apple products.) Given by Tim Myer, Nancy Fisher, and John Patrick Russell, the lecture focused on a rapidly developing idea in "desktop publishing": the collaboration of a microcomputer, innovative software, and a laser printer, which facilitates the flow of information into and out of the office.

Desktop publishing itself is a relatively new concept, a more time- and cost-efficient way of producing letter- or typeset-quality material. Previously, an office's main alternative was to purchase costly, dedicated in-house typesetting systems. As a result of the advances made in the computer industry over the past several years, all-encompassing systems have become cheaper and faster. Graphics and text can be integrated, eliminating the need for commercial printers. What separates the component system from its "dedicated" predecessor is its comprehensiveness—no one system before was able to unify all of the parts of a publishing system for everyday office use.

John Patrick Russell showed us how text and graphics can be cut and pasted using a Macintosh computer, MacPaint and MacWrite software, and the Apple LaserWriter. Technology has progressed to the point where a photograph or videotape can be "digitized" through special equipment (such as the ThunderScan scanner), stored on a disk, and manipulated into a column layout. It can then be enlarged, reduced, cropped—anything that can be done with a physical reproduction—on the screen.

You can also select various type styles and sizes, and column widths; you can experiment with these without having to actually go through the mess and headaches production people normally suffer.

I found it unfortunate that support has not developed for Heath/Zenith users in this area to the point it has among the competition, although the LaserWriter is adaptable to the '100 and '150. The missing ingredient is compatible software.

The finished product, which was handed around, was higher than letter-quality. The resolution, however, was not nearly as high as what you see in a magazine which, like this one, is photo-typeset. The LaserWriter can manage only 300 dots per inch, whereas the film printer for a magazine typically generates 1,200 d.p.i. To the naked eye, the distinction between the two is fine. So, in terms of producing everyday printed matter that would normally be sent to a commercial printer, the desktop publishing system looks to be a lucrative investment.

Let's hope Heath/Zenith technology keeps progressing in that direction.

Dining with the HUGgies

With time to kill between the closing of the exhibit area and the start of the banquet, we decided we'd go for a quick swim, but somehow got sidetracked into the lounge. We arrived at the banquet in time for the salad. The rest of the meal was rather hastily served, from the main course to the chocolate mousse, St. Louis style.

About 45 minutes into the dinner, Charlene Ferguson of Zenith spoke about the award of the Z248 contract by the Air Force; it took eight months and about a million dollars just to get the proposal to the Air Force. The final sale of 90,000 units for approximately a quarter billion dollars, however, seemed the just deserts for Zenith's hard work and perseverance.

Vendors contributed generously to the drawings held at the booths and at the banquet. Jim Buszkiewicz played Don Pardo to Bob Ellerton's Monty Hall in the Midwest HUGCON's version of "Let's Make a Deal." "Don" called out members of the audience to "come on down" and win a prize, while "Monty" asked the lucky contestants to choose the contents of his envelope, or pick door number "1," door number "2," or door number "3." The only thing missing was Carol Merrill.

While most prize winners were receiving products from the vendors, some winners seemed to come up short. Two attendees won a battery each, one a software catalog, and another a key ring. At the end of the banquet, each recipient of one of these "booby" prizes was called up to claim a "real" prize.

The batteries fit inside two ZP150 laptop computers; the software catalog accompanied an HF148 computer and monitor, and the key ring went with a key which started up a Z241 with monochrome monitor. Joe Schulte of Veritechnology made the presentations.

This time, we vowed we would go for a midnight swim, but by the time we left the lounge, the pool was locked up. Having a midnight snack seemed the logical alternative. Domino's delivered us a pizza within the time they had promised.

Wrapping up the show

We had three hours on Sunday morning to make our final sales. I'm told it got fairly busy. At twelve, we began our teardown.

Janet tried to get Barry Watzman to buy a Dysan Interrogator she'd won for the '100, since she doesn't own a computer, but Barry's offer was too low. Janet figured she could always sell it in *Buss*. Janet and Bob Gray, of Graymatter Applications Software, haggled a bit and finally agreed upon a price.

John Gill won a PAL chip with RAM-disk software, which allows boosting the memory of the '150 to 1.2 megabytes. He graciously sold it to Sextant Publishing Company, since he's not a computer owner, either. Charlie, our editor and publisher, won a $100 gift certificate from Heath.

One member of the audience at the question-and-answer session said, "So that's why *Sextant* comes to these things." We-e-e-l-l-l-l. . . .

After teardown, we all went to the New Orleans-style brunch in the inn's restaurant. It was a feast for the eyes (and stomach!): Eggs Benedict with sausage and bacon, roast beef, creole shrimp, spicy chicken, fruit salads, and every kind of pastry, cake, fruit, vegetable, and bread imaginable. Unfortunately, my eyes are bigger than my stomach, so I had a little more than I thought I could handle.

Photo by Charles Floto

Tom Jorgenson of Software Wizardry and First Capitol Computer had the longest booth frontage to cover.

We showed up for our flight over an hour before its scheduled departure, but that didn't stop us from getting delayed. Apparently, TWA had overbooked its flight originating in Phoenix, and we had to wait several hours for the next flight home. Luck was with us again, though, because we each received a voucher for $200 in future flight travel for volunteering to wait.

I thought of all the places I could go with my "windfall": Rome, London, Paris, Madrid. Well, I'd already seen St. Louis. . . . △

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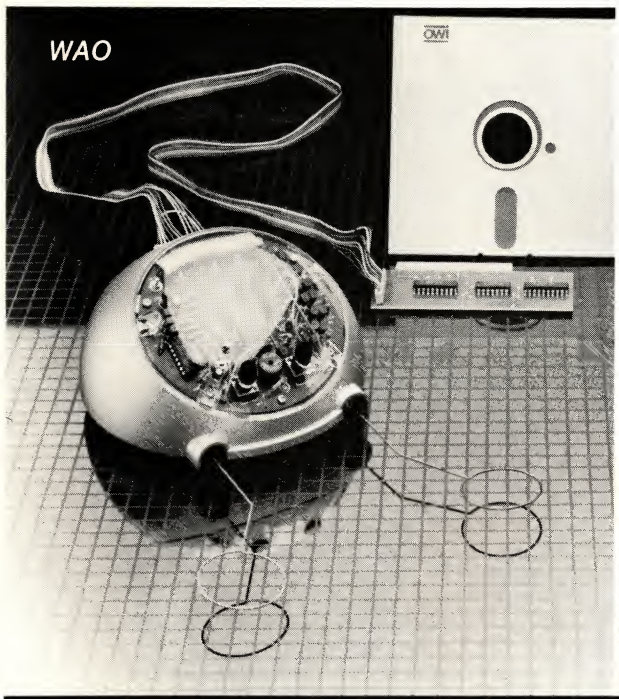

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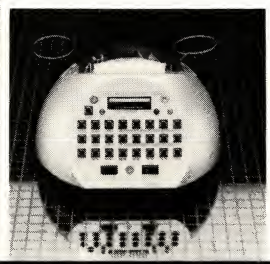

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Supplier Notes

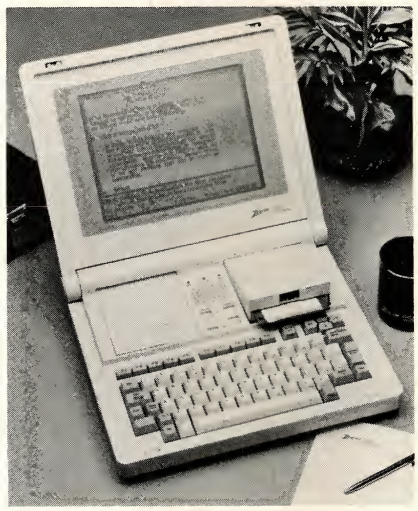
Zenith Portable Offers Greater IBM-Compatiblity, More Readable Screen Than Its IBM Rival

The new Z181 portable personal computer was introduced this past June by Zenith Data Systems.

This 11.8-pound machine (including the battery pack) has a CMOS 80C88 16-bit processor, and runs under MS-DOS. It uses the same BIOS as the Zenith Data Systems Z150-series computers, making it fully compatible with software written for IBM's desktop machines. In contrast, IBM's own portable with 3½" drives, the Convertible, uses a BIOS which is incompatible with some earlier software—including Lotus 1-2-3.

According to ZDS Marketing Manager Andrew Czernek, most software sold on 3½" disks will run with either the Z181 or the Convertible BIOS—if necessary, installing itself for the environment detected.

But Zenith is boasting more than compatibility. The Z181's video display does not suffer from the usual limitations encountered in a portable. Zenith is using a new liquid-crystal display screen with rear illumination. A typical liquid-crystal display without rear illumination has a contrast ratio of 3:1; earlier backlit displays (such as the Z171) have contrast ratios of six or seven to one. The Z181's is as high as 12:1, and compares relatively well with the typical ratio of 15:1 found in many monochrome monitors.



The Z181 portable personal computer

The Z181's screen measures 10.5" diagonally. It holds 25 lines of text, with 80 characters per line. The size and aspect ratio of the screen prevent images from appearing compressed in height.

Standard features of the Z181 include composite video and RGB output, an RS-232C serial port, a parallel printer port, an interface for a 5¼" disk drive, a real-time clock, a rechargeable battery with a life of 3 to 5 hours, and an AC adapter/battery charger.

Z181 options include an internal modem (under $300), a bar-code reader interface, an external 5¼" drive, a carrying case, a cigarette-lighter adapter/charger, an extra battery pack, and an external battery charger. An optional software and cable package will support file exchange with Z150-series computers.

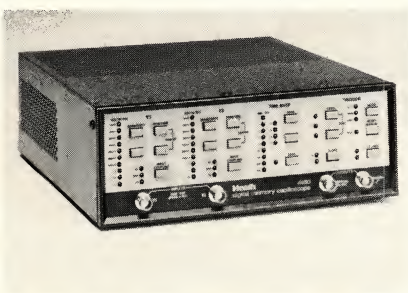
The Z181 measures 13.4" wide by 11.6" deep. The screen can be tilted throughout a 150-degree range. When closed, the '181 is 3.1" thick.

For more information, contact Zenith Data Systems Corporation, 1000 Milwaukee Avenue, Glenview, IL 60025; 800/842-9000, ext. 1.

Two New Computer Oscilloscopes Available From Heath

Heath Company has announced two new oscilloscope peripherals for the Z150 and compatibles: the IC-4802 Computer Oscilloscope and the ID-4850 Digital Memory Oscilloscope.

Both are interfaces that turn your computer into a dual-trace 50-megahertz digital storage oscilloscope with a fast 7-nanosecond rise time. They are designed to enhance the computer's function beyond word processing and spreadsheet use by adding testing capabilities to any Z150-compatible computer.



The ID-4850 Digital Memory Oscilloscope

The Digital Memory Oscilloscope, in addition to its use with a computer, can be used as an oscilloscope upgrade. If you own a low-bandwidth oscilloscope, the ID-4850 will greatly increase your current equipment's range and abilities.

Software supplied with both models enables full programmability of the oscilloscopes from the keyboard of the computer. The computer displays the dual traces, one for each channel, on an 8 by 10 division graticule. There are three display modes: Y1, Y2, and Dual. All displays are chopped, except for the highest time base range, which uses an alternate display. Waveform displays can be stored on a floppy disk for later use as a reference or for waveform manipulation, such as signal averaging.

Both computer oscilloscopes measure 4½" H by 12½" L by 10" W, and weigh approximately eight pounds. Both require a null-modem cable.

To use the ID-4850 with a low-bandwidth oscilloscope, two BNC-to-BNC cables are provided. Your oscilloscope must have a 5-MHz bandwidth or greater, one vertical channel with 0.5-volt/division sensitivity, triggered sweep, and the ability to trigger from a second source.

The IC-4802 Computer Oscilloscope

The oscilloscopes are available in either assembled or kit form. The IC-4802 is priced at $399.95 in kit form, and $575 assembled. The ID-4850 is $499.95 as a kit, and $750 assembled.

For more information, write for a free copy of the Heath catalogue: Heath Company, Department 150-765, Benton Harbor, MI 49022. In Canada, write to: Heath Company, 1020 Islington Avenue, Department 3100, Toronto, Ontario M8Z 5Z3.

Classified Ads

Hardware

H89A, 64K, soft/hard controllers, 2 SS drives, more, $875. H25 printer, $350. 702/673-1690.

GRAPHICS BOARD from SigmaSoft for H/Z89. Includes high-resolution graphics, 256K RAM disk, two parallel ports, two joystick ports. CP/M or HDOS. $395. Don Daugherty, 703/635-4181 days, 703/662-5919 evenings.

SALE: H100 low-profile computer. 8/4.77-MHz switchable clock speed. 20MB internal hard disk. One 5¼" floppy. 64K color video memory, 768K RAM on motherboard. Full documentation. Call 616/428-2609 evenings.

WANTED: H89A, 64K, two DS/DD 96-TPI drives, printer, software. Info and price to Box 68, Matewan, WV 25678.

Z89 with dual 8" 1MB DS/DD disk drives, 64K. Running, good condition. $850. H89 with 5" hard-sector disk drive, 64K. Running, good condition. $500. Bill Scolnik, 800/526-0388 days.

H89 with 64K RAM, H-17, auto repeat, dual RS232C, manuals and much more. Asking $450. 713/890-6131.

Software

Z100 HIGH-RESOLUTION FRACTALS in MODULA-2. The program "Benoit" implements 640 x 480 interlace, variable pixel size, 2D, 3D bar, 3D line, 3D hidden line, screen and data save to allow suspension and restart of plots, full-page Epson FX— shaded screen dump, text output in high-resolution, line-drawing routines, simple windows, and more, in Logitech MODULA-2/86 source code. $21 from Gene Tehansky, Village Software, Rt. 5 Box 188, Mechanicsville, MD 20659. Requires MS-DOS 2 or better, 64K display memory.

Information

PERSONAL COMPUTER OWNERS can earn $1,000 to $5,000 monthly selling simple services performed by their computer. Work at home—in spare time. Get free list of 100 best services to offer. Write: C.I.L.D.H., P.O. Box 60369, San Diego, CA 92106-8369.

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To get in touch with your fellow Heath/Zenith users, place your short notice in *Sextant*'s classified section. The rate is only 75¢ per word, with a minimum of 15 words.

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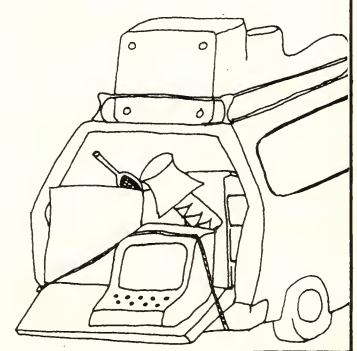

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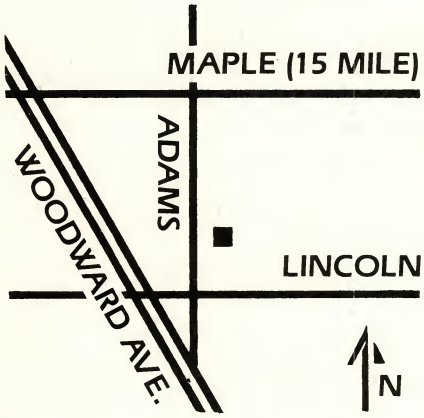

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(Continued from page 7)
shall now do the same to both of you. . .

Jeers. . . . to each of you for printing an article from Richard L. Mueller about the FBE MegaRAM-150. Though the articles are *not* identical, they are obviously the same. Even the order that topics are presented are the same. Okay, so the diagrams are done on a computer for one article and appear to be nice artwork in the other, but the article is *still the same.* Much to my dismay, if you both start printing the same articles, I will certainly decide to subscribe to only one. *Why pay twice for the same thing?*

Cheers. . . . for up to now you have both served a need to the Heath/Zenith users out here in the real world. A "classy" magazine with in-depth articles, and an informational one sent out twice as often. Let's not forget those needs.

Jeers. . . . I realize you are in competition with each other, but let's not go too far with it. It would be hard to make a choice at this point, but price and number of issues would win out. Any possibility that *Sextant* will become monthly *without* a price increase?

Well, I guess that is about all that I have to say for now to either one of you. I don't expect you will print this, 'cause if you do, probably both of you will have egg on your face one way or another. Too late? Oh well—need any contributing writers?

Thanks in advance for taking the time to read this letter; it is only intended as a method of getting more from my subscriptions by letting you know the positive and negatives.

Douglas R. Roberts
Richmond, ME

We didn't know the article had been submitted to REMark *until we received the July issue. And we believe they didn't know it would appear in* Sextant. *We certainly share your dismay at this unprecedented duplication.*

Thank you for letting all our readers know your reaction.

Update on Seidl Make Utility

Thank you for your review of the Seidl Make Utility in the July issue of *Sextant* magazine ["C Notes"]. Seidl Computer Engineering has moved since the SMK software was sent to you for review, and now has a new address. . . . We are now located at 3106 Hilltop Drive, Ann Arbor, MI 48103. Our new phone number is (313) 662-8086.

The price that was listed for SMK was also incorrect. SMK retails for $99.95, plus $3.50 for shipping and handling.

Carol A. Seidl
Seidl Computer Engineering
Ann Arbor, MI

Crazy over the eight-bit world

Halt, stop, hold it. I had decided to save my pennies to buy a "PC," and now you come out with this ridiculous series ["The Eight-Bit World," by Walt Janowski].

My old H89 doesn't run Flight Simulator, and that's what I want to play. Just because I haven't made it to the end of Y-Wing Fighter yet doesn't mean anything.

Just because Walt said VFILE was good is no reason to agree. On a scale of 1 to 10, I would only give it a 9. Now I will have to go and look for VDO, then wait for the 4-MHz mod, then MEX, then I will have to think about Write-Hand-Man. Then, then, then. Troublemaker!

No, I am going to get a PC so I can get Word. You know TEXT, the print formatter, is so cheap it has to repaginate a document up to the page you want to print out. I am going to get a PC, then Word, and still have the same problem for over a thousand dollars. Sounds reasonable to me. Hmmmmm—

I think I will find a nice, new label that says Zenith Systems, and put it over the old Heathkit H89 label. Then I will get a slow stopwatch so I can increase the speed to 8 MHz, then I will think positive that all the electrons are running around in groups of sixteen, then I will have a new computer. You think I am crazy, but I'll bet you can't tell, when watching the CPU run, if those electrons are in groups of eight or sixteen. Memory chips. What the heck. They all look the same to me.

You have to be crazy not to buy a PC. I think this letter proves that I am crazy. Please keep "The Eight-Bit World"!

Bob Payette
Tacoma, WA

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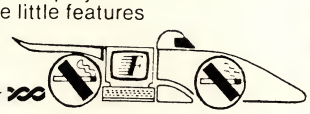

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